# The Digital Transformation of Healthcare

## Exploring Stakeholder Perspectives and Ethical Issues of Digital Technologies in Patient Treatment

Dissertation

zur Erlangung des Grades eines Doktors

rer. pol.

der Fakultät III – Wirtschaftswissenschaften, Wirtschaftsinformatik
und Wirtschaftsrecht der Universität Siegen

vorgelegt von

Marius Müller

| | |
|---|---|
| Erstgutachter: | Prof. Dr. Dr. Björn Niehaves |
| Zweitgutachter: | Prof. Dr. Rainer Brück |
| | |
| Dekan: | Prof. Dr. Marc Hassenzahl |
| | |
| Datum der Disputation: | 22.02.2021 |

## Acknowledgements

This dissertation and the included publications are the result of an exciting journey. I want to acknowledge and thank those people, who accompanied me and contributed to this work. In particular, I would like to thank …

… my supervisor for providing me with the environment and knowledge to pursue my goal,

… my co-authors and colleagues for their valuable input and contributions,

… my wife and my parents for their support and companionship.

Siegen, February 2021 Marius Müller

# Table of Contents

## List of Figures

## List of Tables

# Abbreviations

| | |
|---|---|
| AMCIS | Americas Conference on Information Systems |
| CEPE | Computer Ethics Philosophical Enquiry |
| FTFC | Face-to-Face Consultation |
| GP | General Practitioner |
| HICSS | Hawaii International Conference on System Sciences |
| ICIS | International Conference on Information Systems |
| ICT | Information and Communication Technology |
| IF | Impact Factor |
| IS | Information Systems |
| JMIR | Journal of Medical Internet Research |
| JMI | JMIR Medical Informatics |
| mHealth | Mobile Health |
| RQ | Research Question |
| SQBP | Status Quo Bias Perspective |
| VC | Video Consultation |
| VHB | Verband der Hochschullehrer für Betriebswirtschaft e. V. |
| VR | Virtual Reality |
| VSD | Value Sensitive Design |

# Part A

# 1 Introduction

## 1.1 Digital Transformation in Healthcare

Many healthcare systems around the globe are increasingly facing challenges when it comes to providing comprehensive care and opportunities for treatment, for instance, due to the ongoing demographic change and ageing society (Davis and Bartlett, 2008; Zhong, 2011), which leads to higher patient numbers and an increase in age-related health issues (Demiris and Hensel, 2008). These issues are often paired with structural and spatial disparities, especially in rural locations, which results in inequitable distribution of medical facilities and practitioners as well as impediments in access to care (Politzer *et al.*, 2001; Wilson *et al.*, 2009). Simultaneously, an exodus of general and specialized practitioners as well as an absence of successors to continue their practice can be observed in many rural regions (Adarkwah *et al.*, 2019). The reasons include, for instance, a lack of attraction among young graduates to establish themselves in such areas (Yang, 2003) or an inferior work-life balance due to the high demand per capita (Thommasen *et al.*, 2001). Further, a trend towards the establishment of specialized clinics in urban and more central regions can be overserved, which potentially disadvantages remote areas by taking away much needed expertise (Rechel *et al.*, 2016).

These challenges put increasing pressure on practitioners, who are obliged to adapt and cope with higher workloads. To that end, the application of digital technologies and telemedical solutions in healthcare has been shown to be a suitable measure to deal with the threat of undersupply and care delivery shortages, thus functioning as a catalyst for change through technological progress. The uptake of digital approaches in care has led to a plethora of use cases that seek to alter medical routines in order to make them not only more robust and efficient but also outcome-oriented and hence satisfying.

Technologies, for instance, appear in the form of video-based communication and consultation systems, mobile health (mHealth) solutions such as body-worn sensory equipment, measurement units (Aggarwal *et al.*, 2017; Pantelopoulos and Bourbakis, 2010), mobile applications (Barry *et al.*, 2017), visual guidance systems (Tang *et al.*, 2015), as well as orthoses and smart implants (Ledet *et al.*, 2018). These technological advancements have enabled multiple digitally supported treatment scenarios, such as remote consultation with general practitioners (GPs) (Almathami *et al.*, 2020), remote therapeutic examination and treatment (Host *et al.*, 2018; Seuren *et al.*, 2020), spatially independent measurement of patient data and subsequent transfer to the clinic (Pantelopoulos and Bourbakis, 2010; Vesnic-Alujevic *et al.*, 2018), online scheduling of appointments (Nazia and Ekta, 2014), digital prescription (Mayakul and Ayuthaya, 2018), online information about diseases and symptoms (Ahmad *et al.*, 2006), and telemonitoring of at-risk patients (Aamodt *et al.*, 2019).

Besides their impact on treatments and therapeutic procedures, digital technologies also interact with the people who use them as well as their routines, habits, and attitudes. As research has indicated, implementing technology in care delivery processes can alter the relationships between practitioners and patients (Van Woerkum, 2003), calling for new forms of cooperation based on mutual trust (Donaghy *et al.*, 2019; Montague and Asan, 2012). Further, for the effective and satisfactory application of technologies in healthcare, users are increasingly obliged to develop higher levels of technological efficacy (Compeau and Higgins, 1995) as well as health literacy (Adams *et al.*, 2009; Nutbeam, 2008). On the contrary, traditional care does not require consumers to actively contribute to treatments, the use of supportive digital technologies thus calls for new forms of engagement, with the associated skills (Hojat *et al.*, 2010; Van Woerkum, 2003). In addition, patients need to develop their health literacy, which enables them to fathom their health issues and whether digital solutions are appropriate to address them. These advancements can ultimately lead to novel consumption behaviors.

There is a need to integrate multi-stakeholder perspectives in technology design and application, as a result, to account for different expectations, attitudes, needs, and reservations when it comes to using digital technology in healthcare. To that end, multiple approaches, which take an ethical and inclusive stance, have been developed and utilized; these pursue the integration of different stakeholder perspectives on the use of digital technologies in care when it comes to developing, examining, and applying novel systems (Barry *et al.*, 2017). Research has identified that the design of such technological solutions should be aligned with the perceptions of their users to make these technologies more acceptable, desirable, and satisfying to use (Rennick-Egglestone *et al.*, 2016; Vranceanu *et al.*, 2009). In the light of currently low IT adoption rates in healthcare (Karsh *et al.*, 2010), such efforts represent a major scientific task. Several approaches, such as “Responsible Innovation” (Owen *et al.*, 2013) and “Value Sensitive Design” (Friedman *et al.*, 2013), now enable stakeholder-oriented, holistic, and deliberative design and development of digital technologies in healthcare. This dissertation utilizes these participatory and anticipatory approaches as empirical foundations to deliver a deeper insight into different stakeholder perspectives.

## 1.2 Research Questions

As mentioned above, the application of technology in healthcare processes affects structures, routines, and work and treatment environments as well as different stakeholders. Research has indicated that the investigation and application of technologies in healthcare greatly depends on the appropriate integration of stakeholder needs, concerns, expectations, habits, and behaviors (Payton *et al.*, 2011). As a result of this holistic approach, care providers, such as general practitioners and therapists, and care consumers, such as patients and caregivers, both need to be engaged when decisions are on the horizon regarding specific features of technological systems and the respective environments in which they are intended be deployed. With the ongoing digital transformation of healthcare, providers are obliged to integrate technological components into their work processes, which in turn correlates with their formed habits, elaborated routines, and ways to communicate with patients and other professionals. Understanding the way providers perceive and eventually adopt or reject complementary or even substituting technologies is a major prerequisite for a successful and demand-driven transformation of care (Bhattacherjee and Hikmet, 2007). Hence, the first research question (RQ) drives the investigation of the provider perspectives on digital technologies in healthcare, focusing on provider attitudes, expectations, and perceptions:

**RQ 1:** *What factors influence care providers' attitudes towards digital technologies in healthcare?*

To achieve a comprehensive adoption of digital alternatives to traditional care, the willingness of consumers to participate in novel treatment forms is another important factor underlying the implementation and continuous use of digital technologies in healthcare (Or and Karsh, 2009). Therefore, there is a need for studying patients' attitudes towards using digital tools for treatment, delivering in-depth insights and empirical foundations. The second RQ, thus, focuses on the consumer perspectives on digital healthcare technologies to achieve a more holistic view of digitalized treatments and to account for the multi-stakeholder stance taken by this dissertation:

**RQ 2:** *What factors influence care consumers' attitudes towards digital technologies in healthcare?*

Insights gathered through answering RQ 1 and RQ 2 hold the potential to inform concrete design principles and use cases, which can facilitate high adoption rates and satisfying experiences for all stakeholders. To achieve desirable, acceptable, and sustainable technical innovations, approaches like the "Responsible Innovation" framework urge decision makers to be responsive and reflective when developing novel technologies by integrating user opinions based on their perceptions into the design choices (Owen *et al.*, 2013). Translation of the empirical findings into concrete design features is an indispensable step. Hence, the third RQ seeks to unveil the implications for design and appropriate application of healthcare technologies, as drawn from the findings gathered from different stakeholders:

**RQ 3:** *What implications can be drawn in relation to the design and application of digital technologies within healthcare processes?*

### 1.3 Thesis Structure

This dissertation is divided into two parts, A and B. Part A presents the research background, research design, and findings delivered by the included publications. The findings are discussed in the light of the aforementioned research questions, deriving the implications for research, practice, and design. Part B presents the 13 individual publications that are part of this dissertation, consisting of 12 conference papers and one journal article. Note that chapter, table, and figure numbers have been adapted to be in line with the structure of this dissertation. The journal article has been published in the *Journal of Medical Internet Research (JMIR) Medical Informatics* (JMI). The conference articles included in this dissertation have been presented at the *International Conference on Information Systems* (ICIS), *Americas Conference on Information Systems* (AMCIS), *Hawaii International Conference on Systems Sciences* (HICSS), *CEPE/ETHICOMP*, *Internationale Tagung Wirtschaftsinformatik*, *Bled eConference*, and *New Perspectives on Digitalization: Local Issues and Global Impact*.

Table 1 shows all publications included in this dissertation in chronological order.

| # | **Citation** | **VHB**[a] | **IF**[b] |
|---|---|---|---|
| P1 | Heger, O., Jahn, K., **Mueller, M.**, Niehaves, B. (2017), "'Speeding Up Engagement' - A Systematic Approach for Making Use of Facebook Comments for Upstream Engagement", CEPE/ETHICOMP 2017, Turin, Italy. | (-) | |
| P2 | **Mueller, M.**, Heger, O., Niehaves, B. (2018), "Investigating Ethical Design Requirements for Digitalized Healthcare Support: The Case of Ambulatory Physiotherapeutic Assistance Systems", 51st Hawaii International Conference on System Sciences (HICSS 51), Hawaii, USA. | C | |
| P3 | **Mueller, M.**, Heger, O., Niehaves, B. (2018), "Exploring Ethical Design Dimensions of a Physiotherapeutic mHealth Solution through Value Sensitive Design", 24th Americas Conference on Information Systems (AMCIS 2018), New Orleans, USA. | D | |
| P4 | **Mueller, M.**, Heger, O. (2018), "Health at any Cost? Investigating Ethical Dimensions and Potential Conflicts of an Ambulatory Therapeutic Assistance System through Value Sensitive Design", 39th International Conference on Information Systems (ICIS 2018), San Francisco, USA. | A | |
| P5 | **Mueller, M.**, Heger, O., Kordyaka, B., Kampling, H., Niehaves, B. (2019), "Beyond Intuition: Towards a Framework for Empirical-Based Design Theory Building in Design Science Research", 52nd Hawaii International Conference on System Sciences (HICSS 52), Hawaii, USA. | C | |
| P6 | **Mueller, M.**, Heger, O., Kordyaka, B., Niehaves, B. (2019), "Investigating the Influence of Information Incongruity on Trust-Relations within Trilateral Healthcare Settings", 14. Internationale Tagung Wirtschaftsinformatik (WI 2019), Siegen, Germany. | C | |
| P7 | **Mueller, M.**, Oschinsky, F., Freude, H., Reßing, C., Knop, M. (2019), "Exploring the Role of Cognitive Bias in Technology Acceptance by Physicians", 40th International Conference on Information Systems (ICIS 2019), Munich, Germany. | A | |
| P8 | Oschinsky, F., **Mueller, M.**, Niehaves, B. (2020), "Demigods of Technology Use – How Beating the Overconfidence Bias Can Prevent Medical Errors", 53rd Hawaii International Conference on System Sciences (HICSS 53), Hawaii, USA. | C | |

| | | | |
|---|---|---|---|
| P9 | **Mueller, M.**, Knop, M., Reßing, C., Freude, H., Oschinsky, F., Klein, H., Niehaves, B. (2020), “Constituting Factors of a Digitally Influenced Relationship between Patients and Primary Care Physicians in Rural Areas”, 53rd Hawaii International Conference on System Sciences (HICSS 53), Hawaii, USA. | C | |
| P10 | Knop, M., **Mueller, M.**, Freude, H., Reßing, C., Niehaves, B. (2020), “Perceived Limitations of Telemedicine from a Phenomenological Perspective”, 33rd Bled eConference, Maribor, Slovenia. | (-) | |
| P11 | Reßing, C., **Mueller, M.**, Knop, M., Freude, H., Niehaves, B. (2020), “Building Digital Bridges: Exploring the Digitized Collaboration of General Practitioners and Mobile Care in Rural Areas”, 26th Americas Conference on Information Systems (AMCIS 2020), Salt Lake City, USA. | D | |
| P12 | **Mueller, M.** (2020), “Exploring Emerging Patient Responsibilities in Telemedicine Use: An Empirical Study”, In Radtke, J., Klesel, M., Niehaves, B. (Eds.): New Perspectives on Digitalization: Local Issues and Global Impact. Proceedings on Digitalization at the Institute for Advanced Study of the University of Siegen, Siegen, Germany. | (-) | |
| P13 | **Mueller, M.**, Knop, M., Niehaves, B., Adarkwah, C.C. (2020), “Investigating the Acceptance of Video Consultation by Patients in Rural Primary Care: Empirical Comparison of Preusers and Actual Users”, JMIR Medical Informatics, Vol. 8 No. 10, p. e20813. (https://doi.org/10.2196/20813) | (-) | 2.58[c] |

[a] VHB-JOURQUAL3 (https://vhbonline.org/vhb4you/jourqual/vhb-jourqual-3/)

[b] Impact Factor

[c] IF according to the Journal Citation Reports released in 2020

Table 1: Overview of Publications

# 2 Research Background

Over the last two decades, exploration of the design, implementation, use, and impacts of digital technologies in healthcare has become quite popular in scientific circles. Researchers in various domains such as psychology, computer sciences, or public health have identified that digital solutions represent a promising approach to addressing the diverse challenges prevalent in today's healthcare systems. As a result, Information Systems (IS) research has a rich history of studies on the application of information and communication technology (ICT) in healthcare settings; IS appears to be predestined for examining the impacts of ICT in treatment processes due to the process orientation of the domain and its focus on understanding underlying mechanisms. IS research can contribute to understanding how technologies in healthcare function and add value to structures and routines by shedding light on the ongoing processes and people who are involved, offering a stakeholder-oriented perspective. Researchers have studied the application of ICT in organizations such as clinics and doctors' offices and have guided the development of electronic health services that aim to improve treatment quality and efficiency (LeRouge *et al.*, 2007; Payton *et al.*, 2011) as well as investigated the impact of ICT on resource allocation and the freeing-up of capacities (Yeow *et al.*, 2015).

Clearly, IS can play a significant role in reorganizing care delivery processes and investigating the technological impact on individual and system-related outcomes. ICT has been identified as a promising measure to make healthcare systems more accessible and affordable, providing an opportunity for IS researchers. In this regard, Fichman *et al.* (2011) provided six theoretically distinctive elements of the healthcare context that are particularly important regarding the application of ICT in care: (1) Technology can help to avoid medical errors and achieve higher transparency, potentially leading to improved outcomes; (2) medical data and information are highly personal and at the risk of being accessed by the wrong people or organizations; (3) healthcare entails strong regulations and competition, which hampers the sharing of patient data and, thus, reduces efficiency; (4) healthcare is hierarchically organized, so that key figures in the domain can resist technology adoption and slow down its dissemination; (5) healthcare is multidisciplinary, and so is research and technology and its adoption, which calls for different scientific perspectives; (6) ICT implementation in care delivery is complex, involving multiple stakeholder groups, medical routines and regulations, and the associated technical requirements.

Looking at the six elements described above, the need for a holistic IS research agenda becomes visible, which targets identifying, understanding, and integrating multiple stakeholders' requirements, expectations, routines, and adoption behaviors. In similar vein, Agarwal *et al*. (2010) described three major areas that warrant future IS research, which are the design, implementation, and use of ICT, the quantification of payoff and impact, and extending the traditional realm of healthcare ICT. In this regard, Payton *et al*. (2011) described a digital transformation of healthcare, which inter alia provides clinicians with more holistic patient data, helping them to make better and faster decisions, and thereby leads to patients becoming more aware and active regarding their own health. This enables public health monitoring and research, achieves more streamlined and transparent processes, and leads to new business models and jobs.

As a result, IS research and its methods provide a common ground for investigating the individual and organizational impacts of digital technologies in care delivery and patient treatment processes. This dissertation aims to achieve a deeper understanding of the factors important to care providers and consumers when it comes to using digital technologies for health purposes. Following the research agenda proposed by Agarwal *et al*. (2010), the studies included in this work shed further light on the way technologies are perceived and used by practitioners and patients as well as the design implications that emerge from the empirical findings.

# 3 Research Design

## 3.1 Overview

To address the research questions and provide a holistic view on the design and application of digital technologies in healthcare, this dissertation includes studies that shed light on both the provider and consumer side of care, as well as those that deliver methodological advancements by further integrating stakeholders into research and development processes. Approaches like Responsible Innovation, which take an ethical, inclusive, and anticipatory stance on the development and use of digital technologies, suggest the involvement of different stakeholder groups that hold a legitimate interest in the functionality and impacts of digital healthcare technologies. To account for the heterogeneity of user needs, expectations, concerns, and attitudes, this dissertation involves six papers on the provider angle (P2, P7, P8, P9, P10, and P11) and five papers on consumer perspectives (P3, P4, P6, P12, and P13). Further, considering different stakeholders and their unique needs and expectations, it becomes important to develop and utilize methodological approaches when conceptualizing, designing, and implementing digital technologies within treatment processes. Hence, this dissertation includes two papers (P1 and P5) that propose advancement of knowledge generation based on consumer engagement via social media (P1) and the empirical foundation of design theory building (P5).

Table 2 provides an overview of the included publications as well as the methods applied and data analyzed.

| | # | Method and Data | Reference |
|---|---|---|---|
| Provider Perspective | P2 | Four focus group workshops with practitioners from various disciplines; Analysis using a twofold deductive approach | (Mueller *et al.*, 2018a) |
| | P7 | Proposal of a theoretical framework including expected correlations between various independent variables and one dependent variable (i.e., intention to use); Two planned online surveys using regression analysis and co-variance-based path modelling for data analysis | (Mueller, Oschinsky, *et al.*, 2019) |
| | P8 | Proposal of a preliminary research model; Planned survey with 250 physicians and follow-up interviews using confirmatory factor analysis and inductive coding for data analysis | (Oschinsky *et al.*, 2020) |
| | P9 | Seven semi-structured interviews with general and specialized practitioners; Data analysis following a Grounded Theory approach based on open, axial, and selective coding | (Mueller, Knop, Reßing, *et al.*, 2020) |
| | P10 | Seven semi-structured interviews with primary care physicians; Data analysis using open, axial, and selective coding, followed by an additional informed analysis | (Knop *et al.*, 2020) |
| | P11 | Nine semi-structured interviews with general practitioners and mobile care employees; Data analysis using a thematic approach | (Reßing *et al.*, 2020) |
| Consumer Perspective | P3 | Proposal of a research agenda including focus group workshops with practitioners as well as narrative and semi-structured interviews with patients (precursor to P4) | (Mueller *et al.*, 2018b) |
| | P4 | Four focus group workshops with practitioners from various disciplines and 13 semi-structured interviews with caregivers; Data analysis using a threefold coding procedure | (Mueller and Heger, 2018) |
| | P6 | Planned between-subjects vignette study with an online survey given out to patients; Data analysis using mixed ANOVAs | (Mueller, Heger, Kordyaka and Niehaves, 2019) |
| | P12 | Five semi-structured interviews with primary care patients; Data analysis using a threefold coding approach (open, axial, and selective coding) | (Mueller, 2020) |

|  |  |  |  |
|---|---|---|---|
|  | P13 | 20 semi-structured interviews with primary care patients; Data analysis following a three-fold coding procedure (open, axial, and selective coding) | (Mueller, Knop, Niehaves, *et al.*, 2020) |
| Methods | P1 | Development of a systematic approach based on sentiment detection; Exemplary application using 144 user comments drawn from social media (Facebook) | (Heger *et al.*, 2017) |
|  | P5 | Development of a procedure using empirical data for the creation of design theories; Exemplary application using the four focus group workshops from P2 | (Mueller, Heger, Kordyaka, Kampling, *et al.*, 2019) |

**Table 2: Applied Methods and Gathered Data**

### 3.2 Studies on the Provider Perspective

This work includes six articles (P2, P7, P8, P9, P10, and P11) that shed light on the way digital technologies in healthcare are perceived and assessed by care providers and what attitudes are associated with their perspectives. In particular, different medical professionals were engaged, such as general practitioners, therapists, and care employees, to achieve a comprehensive picture of the respective stakeholder group. The studies described below contribute to answering RQ 1 and RQ 3, unveiling factors that are important to care providers with regard to the design and use of digital technologies in treatment processes.

Accordingly, the first study (P2) covers the formation of ethically driven design requirements following the Responsible Innovation approach. To achieve this, the findings are drawn from explorative and inductive focus group sessions engaging professionals from different domains, such as healthcare, ICT consulting and development, as well as social and computer sciences. The findings suggest that, from a provider standpoint, the following are important factors to be considered when caregivers integrate digital technologies with patient treatment: the acquisition and conservation of a patient's individual skills while using a supportive digital solution in therapy sessions; the degree of autonomy and freedom of choice regarding the execution of treatments; the maintenance of privacy as well as physical and data security; and the design of the technology in a way that a broad and heterogeneous population can use the system, thus avoiding discrimination and exclusion

Looking at what constitutes the attitudes and expectations towards using digital technologies, such as video consultation systems or algorithms that pre-analyze vital data provided by patients, literature on Bounded Rationality suggests that cognitive biases—in the form of loss aversion, regret avoidance, uncertainty, or a lack of perceived benefits compared to the way patients are treated at the moment—might occur when it comes to adopting a new technology and weighing its benefits and associated costs, potentially leading to practitioners opting for the status quo rather than shifting to a digitalized work routine. Here, one of the included articles (P7) utilizes the "status quo bias perspective" (SQBP) to propose a research framework including potential predictors of behavioral use intentions of care providers, in this case general practitioners, adapted from the SQBP. Another article (P8) investigates the role of the overconfidence bias, which can occur when practitioners are deciding for and using a digital technology to render patient treatment more efficiently when demand is high. Hence, it can be assumed that a practitioner's overconfidence has an influence on the way technologies are used and evaluated, and on the extent of medical error that is rooted in digital interventions.

Table 3 provides an overview of the first three included studies on the provider perspective.

| | **P2**<br>(Mueller *et al*., 2018a) | **P7**<br>(Mueller, Oschinsky, *et al*., 2019) | **P8**<br>(Oschinsky *et al*., 2020) |
|---|---|---|---|
| Objective | Design requirements | Research framework proposal | Research framework development |
| Data | Four focus groups | (-) | (-) |
| Technique for Analysis | Iterative categorization | Regression analysis and path modelling | Factor and regression analysis |
| Contribution | Set of different stakeholder perspectives and the corresponding design principles | Research framework and hypotheses based on cognitive biases in technology use | Proposed survey and interview studies to examine overconfidence bias in technology use |

**Table 3: Overview of Studies on the Provider Perspective**

Another study (P9) seeks to uncover factors that describe GPs' perceptions of and attitude towards telemedical solutions meant to support patient treatment. The study in particular looks at the increased level of empowerment patients experience through using digital tools, which impacts the relationship and processes between a healthcare provider and consumer. Based on interviews with general and specialized practitioners, the findings introduce factors that influence the digitally influenced provider–consumer relationship, such as positive and negative effects of empowering and activating patients through ICT, the potential to reduce or increase efforts on the provider side, and the improved practitioner–patient collaboration and mutual understanding in using ICT.

Taking a phenomenological stance that distinguishes between a “measurable objective body” and a “habitual subjective body,” the next paper (P10) covers the identification of technological and treatment-related limitations perceived by practitioners with regard to the use of telemedicine. Findings suggest that perceived limitations of telemedicine in patient care occur in the form of the patient not being physically present, which limits the GP’s perception of the patient as a whole, the formation of a close relationship, and the feasibility of measurements. The article further suggests ways to address these limitations, for instance by providing digital means of communication that foster a strong relationship in the absence of physical contact or by implementing telemedicine (such as video consultation) in treatment processes where it is deemed feasible and appropriate (such as talking about results).

The last study included sheds light on the provider perspective (P11), addressing issues and challenges that relate to the communication between healthcare providers—in this case the GPs and mobile care employees—as well as the potential of using digital technologies to address these issues and achieve more effective collaboration. These two professions exhibit a high degree of mutual dependency and communication, since both fulfill certain tasks in which the patient cohorts overlap. The findings suggest that both actors highly value personal conversations; these can be established digitally to be more efficient and spatially independent so that availability of and access to needed expertise can be increased, as during a home visit or in case of an acute health issue. Further, mutual trust is identified as an important factor, for example to fulfil agreements or for proper documentation. Here, digital technologies can be used to increase the transparency of treatment processes, which in turn can lead to higher levels of trust regarding each other’s work.

Table 4 continues the overview of the included studies on the provider perspective.

| | **P9**<br>(Mueller, Knop, Reßing, *et al*., 2020) | **P10**<br>(Knop *et al*., 2020) | **P11**<br>(Reßing *et al*., 2020) |
|---|---|---|---|
| Objective | Factor identification | Research framework development | Rich description |
| Data | Seven interviews | Seven interviews | Nine interviews |
| Technique for Analysis | Open, axial, selective coding | Informed analysis of codes | Thematic approach |
| Contribution | Different factors that describe the GP–patient relationship in a digital treatment setting | Limitations of telemedicine perceived by GPs | Barriers, challenges and potential in digital communication processes between GPs and care employees |

**Table 4: Overview of Studies on the Provider Perspective (continued)**

### 3.3 Studies on the Consumer Perspective

Besides papers dealing with the provider side of healthcare, this dissertation includes five studies (P3, P4, P6, P12, and P13) that investigate the attitude of healthcare consumers towards the implementation of digital technologies within treatment processes, as well as the associated behaviors and evaluations. To achieve a more comprehensive view on this stakeholder group, patients as well as caregivers were engaged. The studies described below therefore contribute to answering RQ 2 and RQ 3 by examining factors that describe the expectations, attitudes, needs, and behavior of healthcare consumers regarding the use of digital technologies for treatment.

When looking at the development and use of technologies in any given context, the values pursued by the corresponding stakeholders are a major factor that needs to be considered when making design decisions. Here, the Value Sensitive Design (VSD) approach has proven to be an effective way to achieve desirable and user-centered ICT artefacts. In this regard, two papers included in this work (P3 and P4) propose a VSD study that seeks to examine the values pursued by therapists, developers, and caregivers. Further, the identified values are set in relation to each other in order to identify potential value conflicts, suggesting ways for resolution through design. For instance, conflict can arise as to the degree of digital guidance required during a therapy session, which could stand in opposition to the extent of individual skills and experience acquired when working alone.

As already suggested by the findings of a previous study (P4), the level of patients' and caregivers' trust in medical professionals and digital technologies represents an important factor when digital approaches are utilized in treatment processes. Here, another publication (P6) takes a closer look at how the introduction of an ICT artefact in consumer–provider relationships and the likely resultant information incongruities (as in the case of conflicting information being given by a GP and a technology) can affect trust relations among these actors. While relationships between patients and practitioners, in a traditional sense, are based on dyadic processes and mutual trust, modern digitalized settings form a trilateral setting calling for new forms of trust, like in the functionality and accuracy of a given technology.

Table 5 provides an overview of the first three included studies on the consumer perspective.

| | **P3**<br>(Mueller *et al.*, 2018b) | **P4**<br>(Mueller and Heger, 2018) | **P6**<br>(Mueller, Heger, Kordyaka and Niehaves, 2019) |
|---|---|---|---|
| Objective | Research agenda proposal | Value and conflict identification | Study proposal |
| Data | (-) | Four focus groups, 13 interviews | (-) |
| Technique for Analysis | (-) | Iterative categorization, independent coding | Mixed ANOVA |
| Contribution | Research agenda covering focus groups and interviews based on Value Sensitive Design | Several stakeholder values and potential conflicts in technology design and application based on Value Sensitive Design | Proposed vignette study that sheds light on shifting trust relations in computer-mediated care |

**Table 5: Overview of Studies on the Consumer Perspective**

This work also includes two publications (P12 and P13) that seek to illuminate what drives consumers of care to participate in digital treatments. In both cases, primary care patients situated in rural areas were interviewed in order to uncover factors that influence their attitude towards using telemedicine, here in the form of video consultation (VC) deployed by two general practitioners. The first paper focusses on the tasks and responsibilities confronting patients when they take part in a digital appointment. As the findings suggest, patients increasingly step into a consumer role that obliges them to actively co-create treatments and appointments, for instance through a preliminary consideration of the feasibility of a digital meeting in the light of prevalent health issues. A subsequent article (P13) proposes an empirical comparison between pre-users of VC, that is users who have not yet experienced VC for treatment, and actual users who have already used VC. The findings indicate that actual users highly value the perceived benefits of VC (such as saving on time and travel), while pre-users attribute considerable importance to the opinions of their peers regarding participation in telemedical offers, forming a proxy to compare the added benefits of VC.

Table 6 continues the overview of the included studies on the consumer perspective.

| | **P12**<br>(Mueller, 2020) | **P13**<br>(Mueller, Knop, Niehaves, *et al.*, 2020) |
|---|---|---|
| Objective | Factor identification | Factor identification and rich description |
| Data | Five interviews | 20 interviews |
| Technique for Analysis | Open, axial, selective coding | Open, axial, selective coding |
| Contribution | Initial set of patient responsibilities in telemedicine use | Different factors that facilitate patients' acceptance of video consultation in primary care |

**Table 6: Overview of Studies on the Consumer Perspective (continued)**

### 3.4 Methodological Studies

Since this dissertation adopts a multi-stakeholder viewpoint on digital technologies in healthcare, exploring ways to integrate different perspectives in technology design and application appears important. In this regard, one publication (P1) presents a systematic approach to identifying consumer opinions on given technologies based on social media comments. This allows researchers and developers to derive design choices rooted in pros and cons the users (here, potential or current patients) mention when commenting online about digital technologies in healthcare. As a result, technology design and research can benefit from the rich discussion culture that social media platforms such as Facebook provide. Another study (P5) proposes a methodological approach to integrate empirical insights drawn from expert interviews and focus groups when constructing Design Theories relating to given ICT artefacts. The approach allows formulation of alternative design features that can be empirically tested using Structural Equation Modelling. In doing so, features can be identified that most support patient outcomes, such as satisfaction, treatment efficiency, or technology acceptance.

Table 7 provides an overview of the included methodological studies.

| | **P1**<br>(Heger *et al*., 2017) | **P5**<br>(Mueller, Heger, Kordyaka, Kampling, *et al*., 2019) |
|---|---|---|
| Objective | Method development | Method development |
| Data | 144 user comments | Four focus groups |
| Technique for Analysis | Sentiment detection | Iterative categorization |
| Contribution | Procedure to integrate opinions of healthcare consumers and providers in research and design | Procedure for empirical design theory building, for instance in healthcare settings |

**Table 7: Overview of Methodological Studies**

# 4 Findings

## 4.1 Summarized Presentation of Findings

### 4.1.1 Overview

The following sections present findings contained in the included publications and drawn from empirical investigations engaging both providers and consumers of care (see Part B). As the data indicates, in line with the literature, the design and application of digital technologies in care cannot be viewed from a single standpoint only. Following the multi-perspective approach of this dissertation, incorporating different stakeholders into empirical and technical investigations, the findings are presented as a synopsis of provider and consumer perspectives and thus build the foundation for answering RQ 1, RQ 2, and RQ 3. To this end, Subsection 4.1.2 presents insights on the technological potential for increasing availability and accessibility of care. The degree of autonomy and voluntariness patients should be equipped with in a digital treatment setting is set forth in Subsection 4.1.3. Further, the competencies needed to properly assess and use digital technologies in care as well as for increasing patient empowerment are presented. Subsection 4.1.4 delineates patients' responsibilities that emerge in the light of potentially arising obligations and digital treatment alternatives. Subsection 4.1.5 covers the technological impact on consumer–provider relationships, followed by the social dimensions of digitalized healthcare (Subsection 4.1.6). The role of cognitive biases in decision making and behavior regarding the use of digital technologies is pointed out in Subsection 4.1.7. Subsection 4.1.8 shows the methodological advancements that foster a stronger integration of stakeholder perspectives when developing, designing, and researching ICT artefacts that are intended to support treatments and care processes.

### 4.1.2 Availability of Care and Structural Disparities

As the literature and the media have indicated, healthcare systems around the globe face major challenges in providing comprehensive, population-wide care. Many rural areas, in particular, suffer from inadequate access to care due to structural disparities, the lack of professionals and facilities, and inequitable distribution of medical expertise, among others (Adarkwah *et al.*, 2019; Wilson *et al.*, 2009). This combined with ongoing demographic and societal changes has led to demand increasing, while supply stagnates or even decreases, putting pressure on healthcare systems as well as practitioners. In addition, a trend towards centralizing stationary medical services can be observed, such as the establishment of specialized clinics in central areas. This development potentially disadvantages remote areas and can lead to longer travel and waiting times (Rechel *et al.*, 2016).

Based on the findings of the studies included in this dissertation, both providers and consumers of care indicate the potential of digital technologies as supporting tools within treatment processes to overcome spatial disparities and prevailing shortages in healthcare supply and delivery (Mueller, Knop, Niehaves, *et al.*, 2020; Mueller, Knop, Reßing, *et al.*, 2020).

Patients, on the one hand, are highly concerned about the present and future shortcomings regarding the availability of healthcare services, for instance in primary and specialized care. They stress the disadvantages resulting from inferior structures and treatment opportunities, such as long waiting times, long travel distances, or a perceived insufficiency in treatment quantity and quality caused by limited capacities of practitioners. Here, patients see digital solutions such as video consultation (VC) as a promising tool to bridge spatial and personnel-related gaps. Telemedical systems such as VC can shorten waiting times and render travel irrelevant, providing short-term and low-threshold access to care. Further, taking a provider perspective, while patients perceive technologies as potentially enabling physicians to treat more patients, specific disadvantages prevail for providers, such as higher workloads and unnecessary digital appointments (Mueller, Knop, Niehaves, *et al.*, 2020).

Another benefit resulting from the integration of digital solutions in treatment lies in receiving guidance and feedback at home, enabling a higher frequency compared to a face-to-face consultation (FTFC). As the empirical findings show, patients often rely on professional feedback, for instance when they feel insecure about performing specific treatment steps on their own (e.g., medication, therapy sessions, or exercising). Digitally enabled remote treatment and advisory can lead to higher levels of confidence and have the potential to lessen medical errors and detrimental decisions by medical laypeople (Mueller *et al.*, 2018a; Mueller and Heger, 2018).

On the other hand, from a provider perspective, the interviewed practitioners and therapists perceive both benefits as well as disadvantages and increased effort resulting from digitalized treatments. Physicians, for instance, expect a lesser need for home visits, when digital ways are adopted of treating patients remotely. This, in turn, helps reallocate resources and pursue other tasks that otherwise would have to be delayed or might receive less attention. Thus, the interviewees value the fast and omnipresent access to individual medical data without actually seeing the patient. This, however, would demand a specific degree of standardization and processing of data to avoid the physicians being obliged to organize the data on their own (Mueller, Knop, Reßing, *et al.*, 2020). In a related but different vein, interviews with GPs and mobile care employees indicate that the introduction of digital technologies within organizational processes can lead to reducing communication barriers between different providers. Once again, the level of standardization of digitalized communication and organization processes represents an essential factor when trying to achieve an effective and satisfying work environment. Findings show that digital technologies can help practitioners to collaborate in a spatially independent way, such as through digital documentation or reassuring video calls during home visits. This, in turn, can help to lessen the effort associated with cooperative processes such as outpatient care, achieve greater transparency in individual patient treatments, and enhance trust in each other's work (Reßing *et al.*, 2020).

Study participants are also skeptical of digital technology in care. For example, digital appointments via VC can necessitate follow-up meetings on site, due to the limitations of the technology and the provided data and stimuli. This happens because VC systems provide a limited view on the patient and restrict the portfolio of feasible examinations (Knop *et al.*, 2020). Further, medical information and advice given by digital services and tools (e.g., via online platforms or sensory consumer equipment) can lead to wasteful efforts at resolving potential misinformation or mistreatments, thereby increasing the workload for practitioners and negating the aforementioned positive effects (Mueller, Knop, Reßing, *et al.*, 2020).

### 4.1.3 Autonomy, Voluntariness, and Empowerment

Both providers and consumers of care stress that the use of digital technologies within treatment processes should incorporate a level of freedom that aligns with the users' requirements and expectations. In particular, the level of user autonomy and voluntariness plays a role in when a user is about to use the technology—and hence adopt or reject it—during treatment or consultation processes. Findings suggest that a user, whether provider or consumer, is seen to be an autonomous decision maker with the right to waive a digitally supported treatment alternative, such as video consultation with a GP or the execution of a remotely guided therapeutic exercise. Under voluntariness of use, patients claim the need to be in charge, and if needed to be able to stick to traditional treatment patterns, even if those seem to warrant higher effort compared to digital alternatives (Mueller *et al.*, 2018a; Mueller, Knop, Niehaves, *et al.*, 2020; Mueller and Heger, 2018).

Further, primary care patients indicate that their perceived health status and the potential treatments deemed appropriate lead them to opt for a specific form of treatment. For instance, if prevailing health issues are perceived as warranting remote treatment or online consultation, the willingness to participate in digital processes increases (Mueller, Knop, Niehaves, *et al.*, 2020). On another note, looking at caregivers who treat the patients (here, their children or relatives) at home following a physiotherapeutic treatment procedure, an adaptable level of autonomy is needed during these independent treatment sessions. Caregivers state that the way the treatment is performed largely depends on how the patient reacts to the stimuli (Mueller and Heger, 2018). It becomes apparent that both caregivers and patients develop their own ways of dealing with health issues and performing therapeutic measures based on the input and training from professionals. This indicates that consumers of care who participate actively in treatment processes achieve higher levels of literacy towards their own or the patients' health.

Consequently, digital technologies applied within treatment settings are expected by care providers to maintain or increase literacy, self-efficacy, and autonomy among users. For instance, interviewed physiotherapists state that the individual development of skills and experience of the caregivers regarding the correct and often flexible execution of treatments is essential to the patient's progress and well-being (Mueller *et al.*, 2018a, 2018b; Mueller and Heger, 2018). Similarly, GPs who participated in a study on digitalized primary care indicate that patients who are better able to fathom their health status, assess the feasibility of specific treatments, and take care of themselves are a welcome result of digitally provided information on health issues and therapies (Mueller, Knop, Reßing, *et al.*, 2020).

This phenomenon is generally subsumed under the term consumer empowerment or activation. Patients increasingly become empowered to play an active role in healthcare through using digital technologies and having access to information that was formerly the preserve of professionals only. While the mentioned benefits speak for empowered consumers of care, there are emerging issues that overshadow potential positive effects. For instance, according to the interviewed GPs, patients who autonomously acquire information on their health status and seek advice for treatment on the Internet tend to form expectations and potential misconceptions about what form of therapy suits them best. Here, the lack of health literacy and medical competence among patients frequently becomes visible, since the information they have obtained does not correspond to the professional's assessment and view. In that case, as some GPs state, they have to resolve these mismatches and wrong expectations, sometimes contradicting the patient's beliefs (Mueller, Knop, Reßing, *et al.*, 2020). In summary, to achieve a beneficial level of autonomy and proactivity, corresponding degrees of competence and literacy among patients must be ensured.

### 4.1.4 Emergence of Responsibilities and Obligations

Closely linked to the degree of autonomy and voluntariness, which accompanies the introduction of digital technologies in healthcare, an array of responsibilities, tasks, and obligations emerge for consumers of care. As stated above, patients are empowered to play an active role in treatment processes, while providers such as GPs are enabled to delegate portions of their tasks (such as measuring and documenting vital parameters) to the patients. As a result, these digitalized forms of executing treatment steps and procedures induce the mutual responsibility to cope with the associated challenges and contribute to effective and successful use of digital technologies (Mueller, Knop, Reßing, *et al.*, 2020).

From a consumer perspective, looking at the introduction of video consultation (VC) in primary care, the findings suggest that a set of responsibilities and tasks emerges for patients who participate in such digital treatment alternatives. For instance, patients who are about to execute a virtual appointment with their GP are increasingly obliged to run through preliminary considerations and assessment of whether a VC is feasible vis-à-vis the perceived and targeted health issues. As both providers and consumers state, digitalized treatments do not suit every therapeutic occasion, since the portfolio of performable examinations is limited so far. Therefore, patients perceive the urge to reduce the tendency to overuse digital treatment services such as VC with a low threshold of access to the attached medical expertise. This need for a proportionate and thought-out use behavior is also emphasized by the interviewed practitioners, who fear having to put increased effort into handling patient enquiries or waiving unnecessary appointments (Mueller, 2020; Mueller, Knop, Niehaves, *et al.*, 2020; Mueller, Knop, Reßing, *et al.*, 2020).

Further, patients were interviewed about their attitude and intentions regarding the introduction of telemedicine in primary care as a potentially mandatory way of receiving treatment. Especially where the current issues and disparities in comprehensive care delivery in some rural and remote areas persist or even aggravate, offering digital treatments such as VC could represent the only way to care for remote patient groups or those lacking immediate access to care. In that regard, interviewees indicate that they are willing to accept mandatory treatment using digital technologies in case (a) they identify this route as the only available one (for instance due to GPs' extreme preoccupancy) and/or (b) the practitioner in charge urges them to use it (Mueller, Knop, Niehaves, *et al.*, 2020). The latter shows that the patient's GP's advice and the existing trustful relationship play a major role when it comes to adopting obligatory treatment paths. Considering the previous chapter's discussion on patient autonomy and voluntary use, it becomes apparent that freedom of choice becomes subordinated once digital treatments are perceived as the most reasonable way to go.

### 4.1.5 Impacts on Consumer–Provider Relationships

Whereas traditional treatment scenarios commonly involve two actors in the form of healthcare provider and consumer, involving mutual interactions and dyadic decision making, the introduction of technological artefacts in such treatment scenarios leads to a trilateral healthcare setting that incorporates providers, consumers, and ICT (Mueller, Heger, Kordyaka and Niehaves, 2019). Complementing the interpersonal contact, communication and interaction between these human actors, whether on the provider or consumer side, are increasingly mediated by technologies such as online platforms, fitness apps, virtual nutrition and exercise coaches, or technology-enabled self-measurement of vital data such as blood pressure, daily activity and movement, and heart rate through the day. A novel combination of different forms of trust arises, as a result. While traditional (onsite) treatments require patients to trust the practitioners and vice versa, the trilateral setting introduces a (virtual) actor that has to be trusted, too, in order to achieve an effective, satisfying, and safe healthcare experience. Consequently, if patients do not trust the technology used to support specific treatments, the relationship with their GP can serve as a fallback. In case the GP suggested using this technology in the first place, the lack of trust in the technology can negatively affect the interpersonal trust-relationship, too. Similarly, once a mismatch occurs between the information provided by the technology and that by the GP, questions arise on how to resolve this dilemma. On the other hand, patients who exhibit high trust levels towards technology, for instance due to their dispositional innovativeness or positive experience with ICT in other contexts, might value the technology's input over their GP's (Mueller, Heger, Kordyaka and Niehaves, 2019).

Evidently, the introduction of ICT in treatment processes potentially impacts the way relationships are formed, perceived, and maintained. However, the interviewed patients and practitioners stress the point that interpersonal and direct contact needs to be preserved to a context-dependent extent. In this regard, interviewed caregivers indicate that they highly value the degree of humaneness and interpersonal contact in the context of physiotherapy training and execution. Even in a digitalized setting—in this case incorporating sensory equipment to measure and analyze movements and patients' reactions during therapy sessions—the interaction with a human being, who delivers confidence, assurance, and safety, needs to be a substantial part of digital treatment support. The interviewees mentioned that they have formed a strong relationship with the respective therapists, whose input should not be replaced by digitally provided information and feedback only (Mueller and Heger, 2018). It becomes clear then that human and direct contact plays a major role when patients or caregivers are asked to adopt a specific technology.

Another finding gathered from interviews with primary care patients relates to medical issues and treatment occasions that potentially do not require strong relationships and trust between provider and consumer. In particular, when the interviewees were asked whether they could imagine being treated by an unknown practitioner with spare capacities over the Internet, the patients described situations that can be addressed externally. An example is the discussion of measured blood values and the corresponding treatments, which according to the interviewees can be reviewed by any practitioner with the given expertise (Mueller, Knop, Niehaves, *et al.*, 2020). Consequently, digital technologies such as VC enable treatments that (a) can be performed by any suitable practitioner online, (b) free up local GPs by reducing the per capita demand, and (c) represent a novel opportunity for on-demand business models.

Another factor that influences provider–consumer relationships occurs in the form of stereotyping. Some patient groups, most notably the elderly, are often perceived by GPs as lacking technical skills and knowledge, which leads to their inability to use digital technologies properly and effectively in healthcare. Potential operating errors by older users are seen as effort inducing, which can make the operation of telemedical systems tedious and uneconomic (Mueller, Knop, Reßing, *et al.*, 2020). This could result in technology use in treatment processes and patients' lack of computer experience and efficacy having a negative impact on adoption rates on both sides.

### 4.1.6 Social Dimensions of Digital Care

The findings from the included publications shed light on the wide-ranging impact that digital technologies can have on social relationships and interpersonal influences. In the case of caregivers looking after patients (e.g., their infant children), personal contact and mutual awareness must be preserved to a certain extent, while digital tools may, in some cases, jeopardize such mutual understanding. Physicians stress the importance of caregivers developing a sound understanding of the constitution and behavior of the patient. Data delivered by sensors and algorithms that seek to measure, quantify, and document patient behavior and progress is able to enrich the understanding among caregivers and patients, which can lead to a more holistic picture of the therapeutic effect and the resulting health status (Mueller *et al.*, 2018b, 2018a; Mueller and Heger, 2018). Hence, being closely linked to an individual increase in therapeutic efficacy and treatment skills, the introduction of digital technologies that are intended to support therapeutic treatments can foster social relationships and strengthen mutual understanding and communication.

On the other hand, the findings suggest that a section of patients perceive being exposed to social norms and expectations by their social environment with regard to the use of digital technologies in healthcare. Some interviewees are willing to participate in telemedical treatments since they do not want to be socially outpaced by those having a higher disposition towards technology. Looking at this form of peer pressure, which often prompts the willingness to use digital technologies despite lacking the experience and skills, a bias in the form of intergenerational assumptions becomes visible. Many older adults perceive a pressure towards adopting technologies in everyday life coming from younger generations who assume the elderly to be less capable of using technologies properly and effectively (Mueller, Knop, Niehaves, *et al.*, 2020). This bias can also be detected when practitioners deem some of their patients incapable of participating in telemedical treatments effortlessly (Mueller, Knop, Reßing, *et al.*, 2020). Interestingly, though, this alleged lack of skills and technical know-how does not constitute a reason to reject digital advancement in healthcare, according to the older interviewees. The mentioned intergenerational assumptions thus do not endure when talking to the corresponding patient group (Mueller, Knop, Niehaves, *et al.*, 2020). Consequently, to dismantle assumptions and biases across patient groups and practitioners, ensuring mutual awareness of individual circumstances, capabilities, and intentions can lead to higher adoption rates across generations by dissolving potentially erroneous perceptions and can steer behavior towards higher participation.

Further, the responses of patients who have already encountered telemedical treatments and consultations makes it apparent that many of the interviewees were the first people to use digital technologies in healthcare among their peers. They also stated that they influence their social environment by sharing their mostly positive experiences, in this case of virtual consultation with their respective GPs. Thus, these patients, having already adopted a form of telemedicine, represent technological pioneers who could stimulate a further dissemination of telemedical treatment alternatives across the population (Mueller, Knop, Niehaves, *et al.*, 2020). It can be assumed that once an individual encounters telemedicine in healthcare and gathers positive experiences and results, the awareness of digital treatment offered by care providers will increase naturally across potential consumers, leading to higher participation and adoption rates.

### 4.1.7 The Role of Cognitive Biases in Healthcare Technology Use

As the literature has shown, individuals do not act in a strictly rational way. Making highly rational decisions would require the salience and availability of perfect information, which would enable human beings to weigh the pros and cons of a specific decision. However, individuals mostly act on the basis of incomplete information, largely utilizing heuristics that enables them to make satisfying decisions amid uncertainty. Another factor that influences the decision making process and its outcomes is so-called "cognitive biases" rooted in the Bounded Rationality view (Kahneman, 2003; Kahneman and Tversky, 1979; Simon, 1955). This view states that human decisional capacities are limited due to a lack of (complete) information and cognitive boundaries. Cognitive biases may lead to perceptual distortion, inaccurate judgments, illogical interpretations, or even irrationality, while on the other hand they can also result in faster, more effective, or desirable decisions. Thus, they often function as a decisional tool used by individuals in a subconscious or even conscious way.

Cognitive biases have been subject to many prior studies but represent a rather new and emerging concept in research on healthcare technologies and digital treatment processes. As one of the included publications describes, cognitive biases occur in several forms, such as memory biases, perception biases, social biases, or stability biases (Fleischmann *et al.*, 2014). One prominent example of the last is the "status quo bias perspective" (SQBP), which states that individuals often stick to established environments and already made decisions, even in the face of alternatives that appear to be superior from a more objective, holistic view. SQBP contains three dimensions, each including potential predictors of the resulting behavior: rational decision making, cognitive misperception, and psychological commitment (Kim and Kankanhalli, 2009). In the context of healthcare providers who are or will be confronted with adopting digital technologies for treatment or organization purposes, it can be assumed, for instance, that GPs perceive the amount of effort, time, and energy that they have invested to establish their practices, work routines, and medical standing to be very high. Practitioners undergo comprehensive and demanding education to be able to practice. Hence, a technology that is intended to complement or partially substitute elaborate working routines and processes (such as algorithms that automatize the analysis of patients' vital parameters) can be perceived as rendering prior investments, known by the term "sunk cost," obsolete to some extent (Kim and Kankanhalli, 2009). Sunk cost is thus expected to negatively influence GPs' willingness to adopt such digital technology (Mueller, Oschinsky, *et al.*, 2019).

The findings delivered by the studies further indicate social bias, particularly when talking to GPs about the introduction of telemedicine in patient treatment. The concept of stereotyping describes the overgeneralization of a particular group of individuals with regard to their beliefs and characteristics (Oakes *et al.*, 1994). Hence, the behavior of one or a few representatives of this group is (often subconsciously) projected onto a social group (Fiske, 1998). As described in Subsection 4.1.6, stereotyping seems to take place when interviewed GPs deem specific groups of patients unable to use digital technologies in healthcare properly and effectively. Older adults in particular seem to be perceived as lacking technical skills, experiences, and readiness. This in turn inclines some of the interviewed practitioners to form a more negative and dismissive attitude towards telemedicine and its application in patient treatment processes, since they expect increased efforts to properly train older adults or resolve (allegedly) incorrect use and unsatisfactory outcomes (Mueller, Knop, Reßing, *et al.*, 2020).

Another cognitive bias, addressed by one of the included publications (Oschinsky *et al.*, 2020), occurs in the form of overconfidence, which represents an action-oriented bias (Fleischmann *et al.*, 2014). The literature indicates that many medical errors made by physicians relate to cognitive biases as well as inaccurate judgments and decision making (Saposnik *et al.*, 2016). A physician's overconfidence especially is often associated with inaccurate diagnostics and underestimated risks (Pohl, 2004; Saposnik *et al.*, 2016). Consequently, the question arises whether a practitioner's medical overconfidence influences the way digital technologies are perceived and used in healthcare. As mentioned above, digitalized treatment scenarios can represent an alternative to traditional processes, potentially competing with assessments and intentions of the GP. Overconfidence, in this case, can lead to the formation of a dismissive attitude towards technology. However, looking at the benefits of digital treatment support regarding the accessibility and availability of care, for instance in rural and remote areas (see Subsection 4.1.2), the advantages of digital approaches in patient treatment are evident. To conclude, the study under reference proposes the need for linking professional overconfidence with the technology adoption behavior of healthcare providers. Understanding the way practitioners perceive the use of digital technologies and the associated benefits against the background of their own subjective experience and assessments can lead to technology design that fosters higher adoption rates and accompanying levels of satisfaction and effectiveness (Oschinsky *et al.*, 2020).

### 4.1.8 Advanced Approaches in Healthcare Stakeholder Integration

This dissertation concludes with two publications that cover the development of advanced methodological approaches to integrate a variety of stakeholders in healthcare with technology design and implementation processes. To that end, the studies enable researchers, practitioners, and developers to identify attitudinal factors as well as needs, expectations, and perceptions of the stakeholders involved and translate them into effective design features and theoretical assumptions in the form of design-oriented hypotheses, with the ultimate goal of promoting the digital transformation of healthcare.

Prior studies in the field of Responsible Innovation have utilized several deliberative approaches to actively integrate stakeholders and end-users into demand-driven and sustainable design processes. In that regard, the concept of upstream engagement seeks to develop legitimate and prioritized research and development agendas by involving the public as a vast and heterogenous stakeholder group. To that end, findings show that a sentiment detection approach, using data drawn from social media platforms, represents a promising and efficient way to gather opinions of potential users and derive corresponding design principles and features (Heger *et al.*, 2017). Sentiment detection represents a form of text mining seeking to identify opinions and emotions towards something or someone within written text (Liu, 2010) and has been utilized to analyze social media comments (Ortigosa *et al.*, 2014).

The proposed approach consists of six steps covering selection and categorization of suitable comments, extraction and clustering of reasons for acceptance or rejection, identification of determinants for acceptance or rejection, and derivation of design implications. The exemplary application of the developed approach delivers insights on the use of virtual reality (VR) technologies in healthcare. Results unveil different determinants for the acceptance of VR in healthcare, such as educational enhancements through physical exercise, the curiosity towards using it or its potential usefulness, as well as determinants of its rejection, such as a lack of trust in the technology and its functionality, the strain that accompanies its use, or the associated high costs. On this basis, design implications can be drawn, for instance, in the form of VR's potential to teach physicians how to execute examinations or operations correctly or the transparency of the system regarding what data is being collected and how it is processed (Heger *et al.*, 2017).

The second publication (Mueller, Heger, Kordyaka, Kampling, *et al.*, 2019) proposes a methodological approach based on Design Science Research and the development and testing of a so-called explanatory IS design theory (ISDT). ISDT seeks to integrate technical aspects of an ICT artifact and theoretical assumptions into a joint research model, whereas the dependent variable is normatively coined. Another feature of ISDT lies in the inclusion of different design alternatives that can be systematically manipulated and tested against each other, for instance within experimental setups (Niehaves and Ortbach, 2016).

Here, the novelty of the proposed methodological approach lies in the active involvement of stakeholders when ISDTs are formed. Design alternatives incorporated in theoretical models are often rooted in the researcher's intuition and experience, neglecting contextual attitudes, experiences, and expectations pursued by the actual users of the ICT artifact under examination. Further, the approach seeks to fulfill particular quality criteria of design choices included in an ISDT: (1) feasibility of the design (with regard to usefulness and benefit), (2) ethical considerations (with regard to acceptability and desirability), and (3) scientific profit (with regard to the theory's explanatory power). To that end, the proposed procedure consists of two phases—inductive (ideation, focused exploration, and synopsis) and deductive examinations (design extraction and theory construction) (Mueller, Heger, Kordyaka, Kampling, *et al.*, 2019).

The exemplary application of the proposed procedure delivers insights on how a potentially beneficial ISDT can be formed within the context of developing a sensor-based system that is (inter alia) intended to support physiotherapeutic treatments performed by laypeople at home. The inductive phase has revealed that user autonomy, competence, diversity, and privacy represent important aspects that need to be considered. The subsequent deductive phase has revealed different design principles that can be incorporated in an ISDT model, for instance in the form of individual guidance of the user (none, standardized, and individual guidance), which refers to the user's autonomy, and forms of feedback (visual, auditory, and haptic signals), which accounts for the user's competencies. The resulting ISDT proposes cause-effect relations between media richness of the ICT, guidance, and learning outcome, whereas the latter represents the normatively coined dependent variable that be measured objectively (e.g., re-creation of trained treatment) and subjectively (e.g., perceived learning) (Mueller, Heger, Kordyaka, Kampling, *et al.*, 2019). Ultimately, the advanced methodological approach enables researchers to formulate theoretical models that account for multiple stakeholder perspectives, seeking to achieve higher explanatory power and, ultimately, higher adoption rates of the artifact under examination.

## 4.2 Implications for Research, Practice, and Technology Design

The objective of this dissertation is to extend the empirical foundation that sheds light on the application of digital technologies in various healthcare and treatment settings and its impact on the stakeholders, structures, and processes involved. In particular, the included publications provide investigations from different perspectives, encompassing providers such as GPs and therapists and consumers of care such as patients and caregivers. The presented findings could be of interest to different areas of expertise, such as medical practitioners and other providers of care, researchers from different domains such as IS, medical informatics, and healthcare, developers of ICT solutions that are intended to support treatment and organizational processes as well as patients and other consumers of care who are or will be confronted with the choice of novel forms of digitalized healthcare delivery and treatment alternatives or complements. In the following paragraphs, the contributions delivered by the publications as a whole are discussed with regard to the implications for research, practice, and design. The 13 propositions presented here depict a condensation of the empirical outputs, highlighting the key findings and hopefully stimulating further research (Baxter and Jack, 2008).

### 4.2.1 The Provider Perspective

With regard to **RQ 1** (*What factors influence care providers' attitudes towards digital technologies in healthcare?*), the implications of the findings from a provider perspective are multifaceted, throwing up four propositions (1 to 4).

> **Proposition 1:** The incorporation of ICT into treatment processes can lead to improved and inclusive access to care, allowing providers to take care of larger patient numbers more efficiently.

The findings indicate an increase in availability and accessibility of care through the implementation of digital treatment alternatives. Waiting times can be reduced, and the number of patients treated per time frame be increased. This in turn potentially reduces the necessity of home visits associated with outpatient care.

> **Proposition 2:** The use of digital technologies for treatment support can yield more empowered and informed patients, potentially reducing efforts on the provider side and increasing patient compliance.

Through the introduction of telemedical approaches in care, providers can achieve an increase in empowered, informed, and proactive patients, which helps to reduce the effort for providers and to establish a common knowledge base concerning health issues and suitable therapies. Further, since patients can acquire health-related information and advice in a more independent way, mutual understanding of prevalent issues and feasible treatments increases, although resolving misunderstandings or inappropriate expectations from therapies can involve increased effort.

> **Proposition 3:** To use digital technologies in a feasible way while avoiding extra effort, and achieve shorter and more effective treatment procedures, the suitability of digitally addressing a patient's health issues needs to be evaluated at the earliest.

The necessity for maintaining physical contact to enable a range of examinations that are naturally limited by the design of telemedicine can be detected. Hence, the use of technologies is bound to specific cases where technical support is deemed feasible and beneficial (such as discussing test results). According to the findings, this calls for a more intensive preselection and assessment of patients' health issues and potential treatments, which requires new structures to avoid work overload from unnecessary appointments. This issue can be addressed by engaging trained staff or technological, algorithmic preselection, although this carries the risk of trust issues and unreliable results. However, both approaches involve considerable time, education, and cost.

> **Proposition 4:** To avoid the structural exclusion of specific patient groups and achieve high participation rates, provider-sided perceptions pertaining to individual patients' unwillingness and ICT-related skills need to be dismantled.

Findings indicate that a differentiation of patient types associated with specific characteristics such as demographics and technical skills takes place. From a provider perspective, not every patient may be suitable for telemedical treatment. Therefore, to include the majority of patients and achieve economic and outcome-related benefits, there is a need to empower through education patients who might otherwise struggle with using technology. Again, this issue makes it imperative to establish new structures and the opportunity of individual guidance and training of patients, for instance involving peers or medical staff. Further, the occurrence of cognitive biases, for instance in the form of stereotyping and the consequent propensity to stick to the status quo of established routines, forms another aspect of the digital transformation of healthcare processes. Hence, the deconstruction of prevailing stereotypes to encourage various patient groups to participate in digital care delivery represents an important scientific and practical task.

### 4.2.2 The Consumer Perspective

Regarding **RQ 2** (*What factors influence care consumers' attitudes towards digital technologies in healthcare?*), the findings deliver four propositions (5 to 8) with implications for theory and practice relating to the use of digital technologies in healthcare from a consumer perspective.

> **Proposition 5:** The patients' utilization of ICT for health purposes can contribute to timely treatment and compensate for disadvantages rooted in environmental and structural circumstances.

The aforementioned increase in availability and reduced waiting times and long-distance travel appeals to consumers confronted with digital care, especially in the case of specialist care that is not equally distributed across remote, rural, and more population-dense areas.

> **Proposition 6:** The patients' utilization of and satisfaction with digital technologies in healthcare is determined by the option of a self-determined, demand-driven use, including the right to waive digitalized procedures.

Consumers stress the importance of voluntarily treading the digital treatment path. Patients greatly value the option of personal contact when required due to individual health issues and the associated psychological pressures. Here, the capability of telemedical solutions to convey the same quality of emotions with solicitude is often questioned by consumers, indicating the limitations of digital technologies in healthcare. Further, patients and caregivers indicate the perceived value of autonomy and self-determined use of technology in the light of individual expertise and experiences, which are important for patient satisfaction with outcomes.

> **Proposition 7:** The application of digital technologies in healthcare renders patients more responsible regarding therapeutic outcomes, which calls for an increase of self-awareness and efficacy among consumers.

The findings reveal patients' awareness regarding their (novel) responsibilities, given the emergence of an active patient role. Patients are increasingly encouraged to co-create telemedical treatments, help avoid overuse, and exhibit a targeted, demand-driven behavior regarding technology-supported treatment. Consequently, there is a clear need to raise patients' computer self-efficacy and health literacy so that they are able to use technologies properly, facilitating virtual appointments, and to correctly assess health issues and the need for associated treatments.

> **Proposition 8:** Many patients' willingness to participate in digitalized care is decisively influenced by peer pressure, while the dissemination of positive experiences with telemedicine can be triggered by technological encounters during treatment.

Findings reveal an awareness of the importance of social norms, considering their influence on patients' attitudes towards technology in healthcare. The surveyed consumers frequently indicated that they perceive a social desirability and form of pressure when confronted with digital technologies. Therefore, from a practical standpoint, incorporating social cues in the form of the behaviors and attitudes of patients' peers into telemedical offers appears to be one way to increase adoption rates across the patient population. An emerging pioneer role of telemedicine users becomes visible here. Consumers who have already encountered digital treatment influence their peers by conveying positive or negative experiences. Thus, social networks play an important role regarding the dissemination of digital treatment alternatives. Ultimately, the findings imply that a mutual understanding between different generations should be established by deconstructing potentially biased perceptions of each other's skills, intentions, and attitudes regarding the use of digital technologies. In particular, this could be achieved through joint workshops requiring younger and older patients to build a common understanding of where and how technology can be used in healthcare.

### 4.2.3 The Design Perspective

Finally, with regard to **RQ 3** (*What implications can be drawn in relation to the design and application of digital technologies within healthcare processes?*), several meaningful design implications can be drawn from the findings in the form of five propositions (9 to 13), contributing to theorizing about digital technologies in healthcare and their respective designs.

> **Proposition 9:** The quality and quantity of virtual guidance presented to patients during treatment influences their perceived autonomy, which can lead to improved outcomes and therapy compliance.

The targeted implementation of different levels and forms of guidance during treatment-related tasks performed by patients or caregivers emerges as a promising way to increase user autonomy. Findings suggest that the extent of perceived autonomy during therapeutic exercises, which is rooted in individual experiences and developed skills, impacts how progress and outcomes are evaluated. It can be assumed that the more the guidance (for instance providing step-by-step instructions via video or sound), the more it limits the users' ability to emphasize their individual preference and if necessary adopt a potentially deviating treatment path.

> **Proposition 10:** The technical incorporation of human-like communicative features that convey interpersonal cues is a prerequisite for achieving the needed levels of trust and feelings of solicitude.

The findings indicate that the extent and quality of human interaction conveyed by digital technologies within treatment processes forms an important factor that design choices should consider. Since relationships between consumers and providers of care are often very intimate, trustful, and complex, such as the relation between patients and their GPs in primary care, there is a need to design and implement telemedical solutions in a way that fosters the perception of mutual presence and solicitude. In technology design, this can be achieved by implementing features that deliver a feeling of social presence. Looking at some of the technologies already implemented in doctors' offices or clinics, such as VC, ways to convey video-based personal contact can already be found. With regard to non-video-based technologies such as text-based nutrition or medication apps, other forms of social presence need to be realized, for instance in the form of individualized text messages provided by the GP.

> **Proposition 11:** Virtual presentation to patients of their peers’ behavior regarding the use of digital technologies for treatment can increase the individuals’ willingness to participate through conveying a sense of social approval.

As already mentioned above, the attitudes and behavior regarding telemedicine use in healthcare of a patient’s peers can have a significant impact on the way the patient perceives the respective technology. Hence, the likelihood of patients participating in digital treatments can increase once they are made aware of others using it successfully. On a design level, this can be achieved via “nudges”, which seek to subconsciously encourage people to behave in a specific way. One example of a digital nudge in the context of telemedicine are individualized messages—e.g., “A majority of your colleagues have already used VC to consult their GP in a satisfying way”—presented to patients in association with using a particular technology. That way, patients become aware of their peers’ behavior when confronted with a similar choice, which can cement the former’s intention to use the technology.

> **Proposition 12:** Providing individual treatment data reflecting progress to the patient in a holistic, accessible, and digital way can lead to higher levels of patient efficacy and self-awareness.

As the findings show, empowering patients to play an active role in healthcare can be a powerful tool to render treatment processes more efficient and satisfying. To do so, patients need to be equipped with tools to acquire information about prevailing health issues and associated treatment opportunities. To this end, technologies that interact with the patient or establish a channel between consumers and providers can be so designed that they convey health-related information in a more sustainable and accessible way. For instance, VC technologies, which provide a virtual environment for patients to consult practitioners effectively in a spatially independent way can be expanded by functions to collect, condense, and present topics, results, and advice discussed during an online consultation for the patient. That way, the information can lead to a deeper understanding of medical measures, procedures, and outcomes, fostering higher levels of individual health literacy.

> **Proposition 13:** Patients are more likely to continuously use and trust a digital technology for treatment if the collected and processed personal data is presented in a transparent, understandable, and controllable manner.

Besides the interpersonal trust between patients and practitioners, the way people interact with technologies and perceive them to be reliable, trustworthy, and functional represents a major task when designing usable and desirable technologies. To that end, it has been shown that users muster higher levels of trust towards technologies with comprehensive and transparent features. In particular, as the findings show, the technology's transparency with regard to what data is collected, how it is processed, and what results are drawn is key to build technology-related trust. Hence, digital technologies that are intended to collect medical data and support treatment procedures should incorporate ways to present their functionality and the data arising therefrom to the users if requested and allow them to individually control underlying protocols, for instance by disabling, enabling, or limiting certain features such as data access by external parties.

# 5 Discussion

## 5.1 Main Contributions

This dissertation delivers a comprehensive set of meaningful insights of great importance for both researchers and practitioners dealing with the ongoing digital transformation of healthcare. As mentioned above, IS research plays a major role in investigating the digital promotion of healthcare processes and structures (Fichman *et al.*, 2011; Payton *et al.*, 2011). The work presented here advances the agenda established by previous IS research (Agarwal *et al.*, 2010) and adds important, novel facets that complement the body of knowledge, such as the emergence of patient responsibility to make digital health work, cognitive biases when assessing technologies and their users, and different shades of voluntariness.

### *Emergence of Technological Determinism in Rural Healthcare*

The different forms of voluntariness and emerging obligations for all stakeholders indicate a form of technological determinism taking place in modern healthcare, implying that technical advancements have the power to dictate how future care scenarios are shaped and trigger social change (Surry, 1997). Thus, considering the ongoing structural and demographic changes that alter the way healthcare is being delivered to citizens, it can be assumed that stakeholder groups are obliged to deal with digital technologies due to a lack of alternatives (e.g., traditional onsite care) and professionals, potentially against their preferences.

Research suggests three mechanisms that can explain why people are compelled to use obligatory technologies: (i) competition between individuals or groups, (ii) dependence on technology, and (iii) the induction of social norms and values through technologies (Chandler, 2012). This dissertation touches upon aspects related to all three mechanisms and, thus, contributes to the understanding of how stakeholders in healthcare form attitudes towards mandatory technology use. First, the findings indicate that competition among patients takes place in the form of social pressure and willingness to participate in digital care. Second, looking at the disadvantageous circumstances described by several study participants in rural regions, telemedical approaches often represent the only feasible way to access needed treatment, which creates new forms of technological dependence. Third, technologies are able to correlate with values and norms pursued by patients and professionals, thus having a reinforcing effect once essential values (such as autonomy, privacy, and well-being) are technically implemented and conveyed to the user.

In conclusion, this dissertation shows that the emergence of technological determinism in healthcare can originate in rural and remote areas that are most likely to experience the impact of supply shortages, centralization of capacities, and the exodus of medical professionals. Understanding the dynamics and antecedents of adopting obligatory technologies, such as the influence of (a) patients' "blind" trust in the GP offering a telemedical service or (b) the individual level of technical know-how on their adoption behavior, has the potential to resolve the problems modern healthcare systems exhibit. Looking at the current state of IS research and the proclaimed agendas, this contribution is a novelty in the field.

### *Advancing Research on Technology Acceptance and Adoption Behavior*

Studies that have sought to investigate and explain users' acceptance and adoption of digital technologies in healthcare show that the explanatory power and share of variance that can be explained by means of the theoretical models fluctuates (Harst *et al.*, 2019; Tao *et al.*, 2020). Theoretical approaches adapt established models such as the Technology Acceptance Model or the Unified Theory of Acceptance and Use of Technology, which—after years of refinement and extension—incorporate a vast set of variables functioning as predictors of use intentions and user behavior. However, these studies often do not conduct a preselection of variables based on anticipated results (Bagozzi, 2007; Or and Karsh, 2009) and neglect contextual factors, which narrows their view on complex phenomena (Salovaara and Tamminen, 2009). In this regard, the findings presented above enable researchers to build and test promising and more targeted research models, potentially yielding higher explanatory power in the light of prevailing high variance. A major contribution of this dissertation thus lies in the proposal of a rich set of meaningful predictors in various fields that are of interest for IS research, such as sensor-based therapy assistance, support of patient treatment in primary care, or telemedical tool use by practitioners.

Another vital aspect that this dissertation introduces to future research on the acceptance of digital healthcare technology lies in understanding how cognitive biases influence the stakeholders' behavioral intentions and actual use of such technologies. Looking at components of popular and widely utilized theoretical models seeking to explain users' adoption behavior, it becomes apparent that these models are rooted in rational assumptions, for instance by weighing benefits (such as increased performance) against the costs associated with a specific technology, which requires its users to be able to quantify this comparison. The decision to adopt a technology, in many cases, is visibly biased and based in heuristics and assumptions that make the decision easier. The findings presented above deliver initial insights, such as that practitioners might tend to reject digital technologies for treatment on the basis of a perceived lack of knowledge and commitment among their patients. Theoretically speaking, this points towards a diffusion of responsibility regarding the effective transformation of care. Thus, individual technology adoption seems to become dependent on others, which is of particular importance when looking at gatekeeper structures associated with patient care. Hence, the conclusions of this work call for a deeper scientific look beyond the rationality that is often taken as a basis when investigating users' decision making and adoption processes.

### *Approaching Novel Business Models and Care Delivery Structures*

The circumstances and challenges associated with current healthcare delivery processes and structures described above point towards the necessity of novel business models and alternatives to traditional treatment scenarios. This dissertation contributes to the depiction of rural and remote areas and the prevailing conditions, unveiling further challenges and individual needs associated with access to care, which lends weight to the call for a swift digital transformation of healthcare systems. In that regard, research has identified that on-demand services show promise in safeguarding comprehensive healthcare provisions while being accessible, convenient, and affordable for a large population (Sterling and LeRouge, 2019). On-demand telemedical services, as opposed to traditional in-person consultations in a reachable facility, are defined as being accessible by patients day and night from any location (Gough *et al.*, 2015). Research shows that patients' interest in contacting a care provider in a flexible way, e.g. from home, is growing for non-emergency cases. Thus, on-demand, patient-initiated treatment through telemedical solutions represents a beneficial business model for providers bringing patients and practitioners together in a cost-effective and efficient way (Sterling and LeRouge, 2019).

In that regard, this dissertation substantially contributes to showing how on-demand consultations can work, achieving increased adoption rates and patient-sided willingness to participate. For this kind of service, empirical studies investigating the patients' expectations and attitudes towards on-demand and spatially separated care are scarce in the literature. Therefore, the findings presented in this dissertation are of great significance. While research has already indicated that patients opt for on-demand or traditional care based on emergency or less critical situations (Sterling and LeRouge, 2019), which is in line with the included work (Mueller, Knop, Niehaves, *et al.*, 2020), the findings show that different health issues demand different levels of mutual trust between patients and practitioners. Less demanding issues that call for a more objective assessment without knowing the individual patient's background and disease history (e.g., evaluation and discussion of self-measured blood pressures) are deemed suitable for on-demand, remote care performed by a less known practitioner in the absence of an already existing relationship. It becomes apparent that virtual consultation to be followed by treatment has to be further delineated. Prior research has extensively looked at factors that influence patients' decisions, between in-person, face-to-face visits and virtually mediated ones (Hammersley *et al.*, 2019; Tates *et al.*, 2017). Here, one major contribution delivered by this work lies in understanding that patients' willingness to use digital technologies in healthcare correlates with their needs, expectations, and requested level of trust and bonding with the treating practitioner. It becomes apparent that on-demand treatment performed by a professional other than the personal GP represents a feasible and beneficial complement to traditional ways of delivering care.

### ***Importance of Ethical Considerations in Digital Healthcare***

The empirical work included in this dissertation further stresses the fact that the way digital technologies are being designed and used in healthcare can lead to decisive conflict, considering that values and expectations among stakeholders differ. Several scientific approaches, such as Value Sensitive Design and Responsible Innovation, have identified the need to integrate ethical considerations in development and implementation processes. One major goal lies in avoiding the categorical exclusion of specific user groups or individuals when it comes to accessing and effectively using digital technologies in healthcare. Potential users, especially those at the margins such as the elderly or disabled, represent minor target groups with special needs, which leads to the development of niche products that do not cater to the entirety of the population (Clarkson *et al.*, 2013). However, due to the urgency of building improved and more resilient healthcare structures with the help of digital tools, there is a need to design and deploy holistic, inclusive solutions. Existing approaches and frameworks that seek to align technical design with ethical issues and stakeholder perspectives often lack the effort to translate empirical insights into concrete design choices and technological manifestations (Van de Poel, 2013). Further, in the case of value sensitive design, there have been several criticisms on the non-observance of the investigators' own attitudes, biases, and influences (Jacobs and Huldtgren, 2018). To that end, this dissertation delivers advanced methodological, multi-stakeholder approaches that foster the design of digital healthcare technologies based on insights drawn from empirical investigations as well as online data, engaging various disciplines, communities, and professionals. In doing so, researchers and developers alike are equipped with powerful tools that account for varied yet sometimes conflicting perspectives while being aware of their own role in the process.

As a result, this work is an important step towards integrating individual attitudes and expectations with concrete design choices through features that account for the involved stakeholder perspectives as well as underlying ethical issues or individual concerns, expectations, needs, and intentions. Through discussing the ethical issues that emerge with the transformational processes in digitalized care, one major contribution of this dissertation lies in bridging the gap between individual concerns, choices made by ICT developers and care providers, and the way care processes are shaped and prosecuted, thus achieving a translation between empirical knowledge, ethical concerns, and technical development. Ultimately, this dissertation has the potential to contribute to an increase in adoption rates of digital technologies in healthcare, facilitating the establishment of a comprehensive, effective, and desirable digital infrastructure that fosters digitalized treatment and helping to mitigate shortages and spatial disadvantages in a stakeholder-centric manner.

### 5.2 Limitations

Qualitative research, which has been utilized in a majority of the included studies, is able to deliver rich insights into phenomena while unveiling factors and interdependencies formerly unknown. In order to achieve higher levels of generalization and external validity, this dissertation calls for further studies based on quantitative measures, engaging wider populations. It presents multiple insights in the form of theoretical issues as well as design principles, along with the technical implications.

However, due to the nature of this paper-based work and its development over time, the studies included are those engaging specific populations involved in the development and scientific examination of specific ICT artefacts (such as digital guidance for physiotherapy). As a result, the sample included in the overall dissertation is limited and does not account for many other stakeholders of ICT in healthcare (such as politicians or healthcare insurers). Again, this limitation provides an avenue for future studies involving complementary samples, which can allow for a comparison of user groups and their interests.

Further, this work does not provide in-depth examination of specific findings or identified factors. The aim of this dissertation is to identify and explore a meaningful set of drivers that influence the way ICT in healthcare is perceived by the providers and consumers of care. As a result, while the findings drawn from the included publications deliver in-depth insights regarding some of the essential facets of digitalized healthcare, this dissertation does not take a differentiated, penetrating look at every aspect that the underlying empiricism has thrown up. It is left to future research to account for the importance of each individual finding. Considering the design implications drawn above, the insights are limited, in the sense that the development of technologies and their actual implementation within treatment processes have not yet been done in some cases, thus lacking real intervention.

### 5.3 Future Research

The findings and limitations presented above open up several research opportunities. First, upcoming studies can take a closer look at inter-generational biases underlying the use of telemedicine by different user groups, and resulting peer pressure. As this dissertation indicates, younger generations perceive the elderly to be less capable of using digital technologies in healthcare contexts in a proper effective manner. This bias can also be observed when practitioners talk about different patient cohorts and their technical abilities and efficacy levels. As a result, interviews with older patients have shown that they perceive a form of pressure coming from their peers, other generations, and healthcare organizations. By trying to resolve this bias via technological designs that foster awareness and understanding of individual circumstances and capabilities, higher adoption rates across generations could be achieved.

Second, another opportunity for future research lies in the patient becoming increasingly responsible for effective implementation and use of telemedicine. Once patients become aware that they play an important role in making digital healthcare effective and satisfying, adoption and use behavior might change, resulting in easing the effort required from providers, while motivating patients to participate in digitalized treatments.

A third promising avenue requiring study is the impact of trilateral healthcare scenarios, incorporating human actors and ICT. This dissertation provides initial insights about potential shifts and changes in existing and emerging trust relations between the involved human actors, i.e., providers and consumers of care, and the utilized technologies. The potential for information incongruities across feedback provided by ICT and providers, in particular, can cause patients to feel insecure and misguided. Here, the proposed hypotheses (see publication P6) provide a starting point for future surveys.

Finally, the given implications for technology design (see RQ 3) call for experimental settings involving scenarios that implement telemedical systems and features. As research has shown, longitudinal studies, asking patients to use a specific technology over time, represent a promising research design to reveal changes in technology use behavior and attitudes (see for instance Dadgar and Joshi, 2018). This can enable researchers to test and evaluate different forms of digital treatment support, for instance in the form of design alternatives as part of theoretical models (see publication P5).

# 6 References

Aamodt, I.T., Lycholip, E., Celutkiene, J., Strömberg, A., Atar, D., Falk, R.S., von Lueder, T., *et al.* (2019), "Health Care Professionals' Perceptions of Home Telemonitoring in Heart Failure Care: Cross-Sectional Survey", *Journal of Medical Internet Research*, Vol. 21 No. 2, p. e10362.

Adams, R.J., Stocks, N.P., Wilson, D.H., Hill, C.L., Gravier, S., Kickbusch, L. and Beilby, J.J. (2009), "Health literacy-a new concept for general practice?", *Australian Family Physician*, Vol. 38 No. 3, pp. 144–147.

Adarkwah, C.C., Schwaffertz, A., Labenz, J., Becker, A. and Hirsch, O. (2019), "Hausärzte (GPs) for Medical education in Siegen-Wittgenstein (HaMedSi) - Assessment of the occupational perspectives of General Practitioners in a rural area", *MMW Fortschr Med*, Vol. 161 No. S6, pp. 9–14.

Agarwal, R., Gao, G. (Gordon), DesRoches, C. and Jha, A.K. (2010), "The Digital Transformation of Healthcare: Current Status and the Road Ahead", *Information Systems Research*, Vol. 21 No. 4, pp. 796–809.

Aggarwal, D., Zhang, W., Hoang, T., Ploderer, B., Vetere, F. and Bradford, M. (2017), "SoPhy: A Wearable Technology for Lower Limb Assessment in Video Consultations of Physiotherapy", *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems*, ACM Press, Denver, Colorado, pp. 3916–3928.

Ahmad, F., Hudak, P.L., Bercovitz, K., Hollenberg, E. and Levinson, W. (2006), "Are Physicians Ready for Patients With Internet-Based Health Information?", *Journal of Medical Internet Research*, Vol. 8 No. 3, p. e22.

Almathami, H.K.Y., Win, K.T. and Vlahu-Gjorgievska, E. (2020), "Barriers and Facilitators That Influence Telemedicine-Based, Real-Time, Online Consultation at Patients' Homes: Systematic Literature Review", *Journal of Medical Internet Research*, Vol. 22 No. 2, p. e16407.

Bagozzi, R. (2007), "The Legacy of the Technology Acceptance Model and a Proposal for a Paradigm Shift", *Journal of the Association for Information Systems*, Vol. 8 No. 4, pp. 244–254.

Barry, M., Doherty, K., Marcano Belisario, J., Car, J., Morrison, C. and Doherty, G. (2017), "mHealth for Maternal Mental Health: Everyday Wisdom in Ethical Design", *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems*, ACM Press, Denver, USA, pp. 2708–2756.

Baxter, P. and Jack, S. (2008), “Qualitative case study methodology: Study design and implementation for novice researchers”, *The Qualitative Report*, Vol. 13 No. 4, pp. 544–559.

Bhattacherjee, A. and Hikmet, N. (2007), “Physicians’ resistance toward healthcare information technology: a theoretical model and empirical test”, *European Journal of Information Systems*, Vol. 16 No. 6, pp. 725–737.

Chandler, J.A. (2012), “‘Obligatory Technologies’: Explaining Why People Feel Compelled to Use Certain Technologies”, *Bulletin of Science, Technology & Society*, Vol. 32 No. 4, pp. 255–264.

Clarkson, P.J., Coleman, R., Keates, S. and Lebbon, C. (Eds.). (2013), *Inclusive Design: Design for the Whole Population*, Springer Science & Business Media.

Compeau, D.R. and Higgins, C.A. (1995), “Computer Self-Efficacy: Development of a Measure and Initial Test”, *MIS Quarterly*, Vol. 19 No. 2, pp. 189–211.

Dadgar, M. and Joshi, K.D. (2018), “The Role of Information and Communication Technology in Self-Management of Chronic Diseases: An Empirical Investigation through Value Sensitive Design”, *Journal of the Association for Information Systems*, Vol. 19 No. 2, pp. 86–112.

Davis, S. and Bartlett, H. (2008), “Healthy ageing in rural Australia: Issues and challenges: Rural healthy ageing”, *Australasian Journal on Ageing*, Vol. 27 No. 2, pp. 56–60.

Demiris, G. and Hensel, B.K. (2008), “Technologies for an aging society: a systematic review of ‘smart home’ applications”, *Yearbook of Medical Informatics*, Vol. 17 No. 01, pp. 33–40.

Donaghy, E., Atherton, H., Hammersley, V., McNeilly, H., Bikker, A., Robbins, L., Campbell, J., *et al.* (2019), “Acceptability, benefits, and challenges of video consulting: a qualitative study in primary care”, *British Journal of General Practice*, Vol. 69 No. 686, pp. e586–e594.

Fichman, R.G., Kohli, R. and Krishnan, R. (Eds.). (2011), “The Role of Information Systems in Healthcare: Current Research and Future Trends”, *Information Systems Research*, Vol. 22 No. 3, pp. 419–428.

Fiske, S.T. (1998), “Stereotyping, prejudice, and discrimination”, in Gilbert, D.T., Fiske, S.T. and Lindzey, G. (Eds.), *The Handbook of Social Psychology*, 4th ed., Vol. 2, McGraw-Hill, Boston, MA, pp. 357–411.

Fleischmann, M., Amirpur, M., Benlian, A. and Hess, T. (2014), "Cognitive Biases in Information Systems Research: A Scientometric Analysis", *Proceedings of the European Conference on Information Systems (ECIS) 2014*, Tel Aviv, Israel, p. 23.

Friedman, B., Kahn Jr, P.H., Borning, A. and Huldtgren, A. (2013), "Value sensitive design and information systems", *Early Engagement and New Technologies: Opening up the Laboratory*, Springer, Dordrecht, pp. 55–95.

Gough, F., Budhrani, S., Cohn, E., Dappen, A., Leenknecht, C., Lewis, B., Mulligan, D.A., *et al.* (2015), "ATA Practice Guidelines for Live, On-Demand Primary and Urgent Care", *Telemedicine and E-Health*, Vol. 21 No. 3, pp. 233–241.

Hammersley, V., Donaghy, E., Parker, R., McNeilly, H., Atherton, H., Bikker, A., Campbell, J., *et al.* (2019), "Comparing the content and quality of video, telephone, and face-to-face consultations: a non-randomised, quasi-experimental, exploratory study in UK primary care", *British Journal of General Practice*, Vol. 69 No. 686, pp. e595–e604.

Harst, L., Lantzsch, H. and Scheibe, M. (2019), "Theories Predicting End-User Acceptance of Telemedicine Use: Systematic Review", *Journal of Medical Internet Research*, Vol. 21 No. 5, p. e13117.

Heger, O., Jahn, K., Mueller, M. and Niehaves, B. (2017), "'Speeding Up Engagement' - A Systematic Approach for Making Use of Facebook Comments for Upstream Engagement", presented at the CEPE/ETHICOMP 2017, Turin, Italy.

Hojat, M., Louis, D.Z., Maxwell, K., Markham, F., Wender, R. and Gonnella, J.S. (2010), "Patient perceptions of physician empathy, satisfaction with physician, interpersonal trust, and compliance", *International Journal of Medical Education*, Vol. 1, pp. 83–87.

Host, B.K., Turner, A.W. and Muir, J. (2018), "Real-time teleophthalmology video consultation: an analysis of patient satisfaction in rural Western Australia: Patient satisfaction with real-time teleophthalmology in rural WA *Host, Turner and Muir*", *Clinical and Experimental Optometry*, Vol. 101 No. 1, pp. 129–134.

Jacobs, N. and Huldtgren, A. (2018), "Why value sensitive design needs ethical commitments", *Ethics and Information Technology*, available at:https://doi.org/10.1007/s10676-018-9467-3.

Kahneman, D. (2003), "Maps of Bounded Rationality: Psychology for Behavioral Economics", *The American Economic Review*, Vol. 93 No. 5, pp. 1449–1475.

Kahneman, D. and Tversky, A. (1979), "Prospect Theory: An Analysis of Decision under Risk", *Econometrica*, Vol. 47 No. 2, pp. 263–292.

Karsh, B.-T., Weinger, M.B., Abbott, P.A. and Wears, R.L. (2010), “Health information technology: fallacies and sober realities”, *Journal of the American Medical Informatics Association*, Vol. 17 No. 6, pp. 617–623.

Kim, H.-W. and Kankanhalli, A. (2009), “Investigating User Resistance to Information Systems Implementation: A Status Quo Bias Perspective”, *MIS Quarterly*, Vol. 33 No. 3, p. 567.

Knop, M., Mueller, M., Freude, H., Reßing, C. and Niehaves, B. (2020), “Perceived Limitations of Telemedicine from a Phenomenological Perspective”, *Proceedings of the 33rd Bled EConference*, Maribor, Slovenia, p. 13.

Ledet, E.H., Liddle, B., Kradinova, K. and Harper, S. (2018), “Smart implants in orthopedic surgery, improving patient outcomes: a review”, *Innovation and Entrepreneurship in Health*, Vol. Volume 5, pp. 41–51.

LeRouge, C., Mantzana, V. and Wilson, E.V. (2007), “Healthcare information systems research, revelations and visions”, *European Journal of Information Systems*, Vol. 16 No. 6, pp. 669–671.

Liu, B. (2010), “Sentiment analysis and subjectivity”, in Indurkhya, N. and Damerau, F.J. (Eds.), *Handbook of Natural Language Processing*, 2nd ed., Chapman & Hall/CRC, Boca Raton, FL, pp. 627–666.

Mayakul, T. and Ayuthaya, S.D.N. (2018), “A Digital Prescription Refill System Based On Healthcare Standard In Thailand”, *International Journal of Applied Biomedical Engineering*, Vol. 11 No. 1, p. 8.

Montague, E. and Asan, O. (2012), “Trust in technology-mediated collaborative health encounters: Constructing trust in passive user interactions with technologies”, *Ergonomics*, Vol. 55 No. 7, pp. 752–761.

Mueller, M. (2020), “Exploring Emerging Patient Responsibilities in Telemedicine Use: An Empirical Study”, *Proceedings on Digitalization at the Institute for Advanced Study of the University of Siegen*, presented at the New Perspectives on Digitalization: Local Issues and Global Impact, Universitätsbibliothek Siegen, Siegen, Germany.

Mueller, M. and Heger, O. (2018), “Health at Any Cost? Investigating Ethical Dimensions and Potential Conflicts of an Ambulatory Therapeutic Assistance System through Value Sensitive Design”, *Proceedings of the 39th International Conference on Information Systems (ICIS)*, San Francisco, CA, USA.

Mueller, M., Heger, O., Kordyaka, B., Kampling, H. and Niehaves, B. (2019), “Beyond Intuition: Towards a Framework for Empirical-Based Design Theory Building in Design

Science Research", *Proceedings of the 52nd Hawaii International Conference on System Sciences (HICSS)*, Hawaii, USA, pp. 5715–5724.

Mueller, M., Heger, O., Kordyaka, B. and Niehaves, B. (2019), "Investigating the Influence of Information Incongruity on Trust-Relations within Trilateral Healthcare Settings", *Proceedings of the 14. Internationale Tagung Wirtschaftsinformatik (WI)*, Siegen, Germany.

Mueller, M., Heger, O. and Niehaves, B. (2018a), "Investigating Ethical Design Requirements for Digitalized Healthcare Support: The Case of Ambulatory Physiotherapeutic Assistance Systems", *Proceedings of the 51st Hawaii International Conference on System Sciences (HICSS)*, Hawaii, USA.

Mueller, M., Heger, O. and Niehaves, B. (2018b), "Exploring Ethical Design Dimensions of a Physiotherapeutic mHealth Solution through Value Sensitive Design", *Proceedings of the 24th Americas Conference on Information Systems (AMCIS)*, New Orleans, Louisiana.

Mueller, M., Knop, M., Niehaves, B. and Adarkwah, C.C. (2020), "Investigating the Acceptance of Video Consultation by Patients in Rural Primary Care: Empirical Comparison of Preusers and Actual Users", *JMIR Medical Informatics*, Vol. 8 No. 10, p. e20813.

Mueller, M., Knop, M., Reßing, C., Freude, H., Oschinsky, F.M., Klein, H.C. and Niehaves, B. (2020), "Constituting Factors of a Digitally Influenced Relationship between Patients and Primary Care Physicians in Rural Areas", *Proceedings of the 53rd Hawaii International Conference on System Sciences (HICSS)*, Hawaii, USA.

Mueller, M., Oschinsky, F.M., Freude, H., Reßing, C. and Knop, M. (2019), "Exploring the Role of Cognitive Bias in Technology Acceptance by Physicians", *Proceedings of the 40th International Conference on Information Systems (ICIS)*, Munich, Germany.

Nazia, S. and Ekta, S. (2014), "Online Appointment Scheduling System for Hospitals–An Analytical Study", *International Journal of Innovations in Engineering and Technology (IJIET)*, Vol. 4 No. 1, pp. 21–27.

Niehaves, B. and Ortbach, K. (2016), "The inner and the outer model in explanatory design theory: the case of designing electronic feedback systems", *European Journal of Information Systems*, Vol. 25 No. 4, pp. 303–316.

Nutbeam, D. (2008), "The evolving concept of health literacy", *Social Science & Medicine*, Vol. 67 No. 12, pp. 2072–2078.

Oakes, P.J., Haslam, S.A. and Turner, J.C. (1994), *Stereotyping and Social Reality*, Blackwell Publishing, Malden, pp. xiv, 255.

Or, C.K.L. and Karsh, B.-T. (2009), “A Systematic Review of Patient Acceptance of Consumer Health Information Technology”, *Journal of the American Medical Informatics Association*, Vol. 16 No. 4, pp. 550–560.

Ortigosa, A., Martín, J.M. and Carro, R.M. (2014), “Sentiment analysis in Facebook and its application to e-learning”, *Computers in Human Behavior*, Elsevier, Vol. 31, pp. 527–541.

Oschinsky, F.M., Mueller, M. and Niehaves, B. (2020), “Demigods of Technology Use – How Beating the Overconfidence Bias Can Prevent Medical Errors”, *Proceedings of the 53rd Hawaii International Conference on System Sciences (HICSS)*, Hawaii, USA.

Owen, R., Stilgoe, J., Macnaghten, P., Gorman, M., Fisher, E. and Guston, D. (2013), “A framework for responsible innovation”, in Owen, R., Bessant, J. and Heintz, M. (Eds.), *Responsible Innovation: Managing the Responsible Emergence of Science and Innovation in Society*, John Wiley & Sons, pp. 27–50.

Pantelopoulos, A. and Bourbakis, N.G. (2010), “A Survey on Wearable Sensor-Based Systems for Health Monitoring and Prognosis”, *IEEE Transactions on Systems, Man, and Cybernetics*, Vol. 40 No. 1, pp. 1–12.

Payton, F.C., Paré, G., Le Rouge, C. and Reddy, M. (2011), “Health Care IT: Process, People, Patients and Interdisciplinary Considerations”, *Journal of the Association for Information Systems*, Vol. 12 No. 2, p. I–XIII.

Pohl, R.F. (2004), *Cognitive Illusions: A Handbook on Fallacies and Biases in Thinking, Judgement and Memory*, Psychology Press, London.

Politzer, R.M., Yoon, J., Shi, L., Hughes, R.G., Regan, J. and Gaston, M.H. (2001), “Inequality in America: The Contribution of Health Centers in Reducing and Eliminating Disparities in Access to Care”, *Medical Care Research and Review*, Vol. 58 No. 2, pp. 234–248.

Rechel, B., Džakula, A., Duran, A., Fattore, G., Edwards, N., Grignon, M., Haas, M., *et al.* (2016), “Hospitals in rural or remote areas: An exploratory review of policies in 8 high-income countries”, *Health Policy*, Vol. 120 No. 7, pp. 758–769.

Rennick-Egglestone, S., Knowles, S., Toms, G., Bee, P., Lovell, K. and Bower, P. (2016), “Health Technologies ‘In the Wild’: Experiences of Engagement with Computerised CBT”, *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*, ACM Press, San Jose, California, pp. 2124–2135.

Reßing, C., Mueller, M., Knop, M., Freude, H. and Niehaves, B. (2020), “Building Digital Bridges: Exploring the Digitized Collaboration of General Practitioners and Mobile Care in Rural Areas", *Proceedings of the 26th Americas Conference on Information Systems (AMCIS)*, Salt Lake City, USA, p. 11.

Salovaara, A. and Tamminen, S. (2009), "Acceptance or appropriation? A design-oriented critique on technology acceptance models", *Future Interaction Design II*, Springer, London, pp. 157–173.

Saposnik, G., Redelmeier, D., Ruff, C.C. and Tobler, P.N. (2016), "Cognitive biases associated with medical decisions: a systematic review", *BMC Medical Informatics and Decision Making*, Vol. 16 No. 1, available at: (accessed 7 October 2020).

Seuren, L.M., Wherton, J., Greenhalgh, T., Cameron, D., A'Court, C. and Shaw, S.E. (2020), "Physical Examinations via Video for Patients With Heart Failure: Qualitative Study Using Conversation Analysis", *Journal of Medical Internet Research*, Vol. 22 No. 2, p. e16694.

Simon, H.A. (1955), "A behavioral model of rational choice", *The Quarterly Journal of Economics*, Vol. 69 No. 1, pp. 99–118.

Sterling, R. and LeRouge, C. (2019), "On-Demand Telemedicine as a Disruptive Health Technology: Qualitative Study Exploring Emerging Business Models and Strategies Among Early Adopter Organizations in the United States", *Journal of Medical Internet Research*, Vol. 21 No. 11, p. e14304.

Surry, D.W. (1997), "Diffusion Theory & Instructional Technology", presented at the Annual Conference of the Association for Educational Communications and Technology (AECT), Albuquerque, New Mexico, USA, p. 14.

Tang, R., Yang, X.-D., Bateman, S., Jorge, J. and Tang, A. (2015), "Physio@Home: Exploring Visual Guidance and Feedback Techniques for Physiotherapy Exercises", *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems*, ACM Press, Seoul, Republic of Korea, pp. 4123–4132.

Tao, D., Wang, T., Wang, T., Zhang, T., Zhang, X. and Qu, X. (2020), "A systematic review and meta-analysis of user acceptance of consumer-oriented health information technologies", *Computers in Human Behavior*, Vol. 104, p. 106147.

Tates, K., Antheunis, M.L., Kanters, S., Nieboer, T.E. and Gerritse, M.B. (2017), "The Effect of Screen-to-Screen Versus Face-to-Face Consultation on Doctor-Patient Communication: An Experimental Study with Simulated Patients", *Journal of Medical Internet Research*, Vol. 19 No. 12, p. e421.

Thommasen, H.V., Lavanchy, C.M., Connelly, C.I., Berkowitz, J. and Grzybowski, S. (2001), “Mental health, job satisfaction, and intention to relocate. Opinions of physicians in rural British Columbia”, *Canadian Family Physician*, Vol. 47 No. 4, pp. 737–744.

Van de Poel, I. (2013), “Translating Values into Design Requirements”, in Michelfelder, D.P., McCarthy, N. and Goldberg, D.E. (Eds.), *Philosophy and Engineering: Reflections on Practice, Principles and Process*, Vol. 15, Springer Netherlands, Dordrecht, pp. 253–266.

Van Woerkum, C.M. (2003), “The Internet and primary care physicians: coping with different expectations”, *The American Journal of Clinical Nutrition*, Vol. 77 No. 4, pp. 1016–1018.

Vesnic-Alujevic, L., Breitegger, M. and Guimarães Pereira, Â. (2018), “‘Do-It-Yourself’ Healthcare? Quality of Health and Healthcare Through Wearable Sensors”, *Science and Engineering Ethics*, Vol. 24 No. 3, pp. 887–904.

Vranceanu, A.-M., Cooper, C. and Ring, D. (2009), “Integrating patient values into evidence-based practice: effective communication for shared decision-making”, *Hand Clinics*, Vol. 25 No. 1, pp. 83–96.

Wilson, N.W., Couper, I.D., De Vries, E., Reid, S., Fish, T. and Marais, B.J. (2009), “Inequitable distribution of healthcare professionals to rural and remote areas”, *Rural Remote Health*, Vol. 9 No. 1060.

Yang, J. (2003), “Potential urban-to-rural physician migration: The limited role of financial incentives”, *Canadian Journal of Rural Medicine*, Vol. 8 No. 2, pp. 101–106.

Yeow, A., Goh, K.H. and Nanyang Technological University. (2015), “Work Harder or Work Smarter? Information Technology and Resource Allocation in Healthcare Processes”, *MIS Quarterly*, Vol. 39 No. 4, pp. 763–785.

Zhong, H. (2011), “The impact of population aging on income inequality in developing countries: Evidence from rural China”, *China Economic Review*, Vol. 22 No. 1, pp. 98–107.

# Part B

# 7 Using Facebook Comments for Upstream Engagement

| | |
|---|---|
| Title | **'Speeding Up Engagement' - A Systematic Approach for Making Use of Facebook Comments for Upstream Engagement** |
| Number | **P1** |
| Authors | Oliver Heger[1]<br>Katharina Jahn[1]<br>Marius Müller[1]<br>Björn Niehaves[1]<br><br>[1]University of Siegen<br>Kohlbettstraße 15<br>57072 Siegen |
| Publication Type | Conference Proceedings |
| Publication Outlet | CEPE/ETHICOMP |
| Status | published |
| Full Citation | Heger, O., Jahn, K., Mueller, M., Niehaves, B. (2017), "'Speeding Up Engagement' - A Systematic Approach for Making Use of Facebook Comments for Upstream Engagement", CEPE/ETHICOMP 2017, Turin, Italy. |

**Table 8: Publication Overview (P1)**

# Making Use of Facebook Comments for Upstream Engagement: A Systematic Approach

*Abstract*: Deliberative activities constitute an essential part of Responsible Research and Innovation (RRI). Within the deliberative dimension of RRI, so-called "upstream engagement" covers activities which try to legitimize, authorize and prioritize research agendas and intentions. Although upstream engagement is an effective approach to include the public in research, its implementation requires time and effort. To address this challenge, we have developed a systematic, Facebook-specific approach for capturing feelings, ideas, options and priorities towards a certain type of technology and integrating them into technology-related research. To illustrate our proposed approach, we have applied it to 'virtual reality' and 'affective technology' as exemplary cases.

*Keywords*: Responsible research and innovation, upstream engagement, technology acceptance, design, social media, Facebook

## 7.1 Introduction

Deliberative activities constitute an essential part of Responsible Research and Innovation (RRI). They aim at involving a broad range of perspectives from stakeholders into the innovation process of technology design [1]. Deliberation includes activities whose purpose is to optimize decision processes and improve socio-technical outputs regarding the emergence of new technologies [2]. By including multiple perspectives, the outcome of the RRI process is expected to be more socially desirable.

Within the deliberative dimension of RRI, so-called "upstream engagement" covers activities which try to legitimize, authorize and prioritize research agendas and intentions [3]. Wilsdon, Stilgoe and Wynne [4] state that upstream engagement „encourages dialogue between scientists and the public to move beyond competing propositions, to a richer discussion of visions and ends", which leads to a broader consensus on the technology at hand. With the objective of ensuring a broad consensus, implementing upstream engagement in a design-oriented innovation process, firstly, means to find out what determines the social acceptance of the technology to be designed. Secondly, implications are then to be derived which inform the design of the technology.

Although upstream engagement is an effective approach to include the public in research and, in doing so, to implement the deliberative dimension of RRI, its implementation requires time and effort. This challenge needs to be addressed by the executing researchers. For instance, setting up workshops or conducting interviews can be time consuming for the researchers and the interviewees as well. To address this challenge, the paper at hand provides a way for a quick and easy implementation of upstream engagement. The first research question here is:

**RQ1:** *How can upstream engagement be implemented quickly and easily?*

Moreover, many people are not interested in participating in research activities when you ask them to. According to a poll [5], most of the respondents do not want to get personally involved. Facebook being one of the most widespread social networks offering plenty of public dialogues provides data that can be made use of to capture a wide range of perspectives in the public. Thus, the paper is led by a second research question:

**RQ2:** *How can already existing Facebook dialogues be utilized for upstream engagement?*

Following both research questions, we have developed a systematic, Facebook-specific approach for capturing feelings, ideas, options and priorities towards a certain type of technology and integrating them into technology-related research. The approach is based on the 'typical' procedure of sentiment detection [6] and methods from netnography [7]. To illustrate our proposed approach, we have applied it to 'virtual reality' (VR, 360° virtual environment with headset) and 'affective technology' (AT, technology that detects the emotional state of its user) as exemplary cases. Finally, we discuss implications for future innovation (processes) of technology design as well as limitations and outlook of our work.

## 7.2 Literature

### The Role of Upstream Activities in RRI

Modern perspectives in social sciences consider public social actors as valuable contributors in scientific discussions and discourses. Scientists are moving away from treating the public as a passive actor that is obliged to deal with the results or products science delivers [8]. Hence, by deliberately engaging these actors, a broader spectrum of societal aspects regarding innovative research can be taken into account when it comes to designing ICT (information and communications technology). Efforts to actively address the public are increasingly encouraged by the ongoing advancement of modern communication technologies (e.g. social media) "which enable active co-operation of user communities in co-creation and diffusion” [9]. User engagement, thus, can have a significant impact on the adoption of a technological innovation [10].

In order to manage public engagement, the so-called upstream is of major interest. By involving the public, development processes of emerging and innovative technologies can be formed collectively [11]. This collective knowledge is needed to address the technology’s future impact, which „lies in the future and so in the emergence phase is still somewhat uncertain and ambiguous“[12]. The ongoing dialogue between researchers, decision makers and public entities is of an interactive and mutual nature and leads to rich and deep data, whereas polls only “measure ‘top of the head’ public views” [13].

### Challenges for Upstream Engagement

The engagement of the public comes with challenges and necessities that need to be addressed by the executing researchers. On the one hand, upstream engagement is affiliated with a fairly high amount of effort when it comes to actively including the public. Opportunities for stepping into a dialogue need to be granted, e.g. by setting up workshops or conducting interviews, which can be time consuming for the researchers and the interviewees as well [14]. On the other hand, it can be hard to encourage the public in actively engaging in research. According to a poll conducted by Shah and Castell in 2011 [15], 56% of the respondents do not feel informed about science and research, although a majority of them think positively of science. Furthermore, “most do not want to be personally involved”. In addition to that, a certain extent of ignorance and lack of knowledge is apparent which can lead to severe tensions between the public and scientific domain, calling for academic enlightenment [16].

In 2014, an event organized by the National Co-ordinating Centre for Public Engagement (NCCPE) revealed several challenges the domain of public engagement will encounter in the near future [17]. For instance, priorities of public social actors are constantly changing, which implies that methodological approaches need to be flexible and, thus, more efficient. Additionally, NCCPE suggests that researchers should partly move away from obvious participants (e.g. social actors that are exposed to a certain technology in their working domain). Instead, the engagement of a broad diversity covering varying and distinct opinions seems promising.

The challenges mentioned above are in line with our systematic approach, reducing the effort of data gathering and analysis while involving large online communities that voluntarily share their opinions with others.

### The Potential of Social Media Upstream Engagement

Social media has potential for engaging the public in research as it attracts a huge amount of different users who are exchanging opinions on all sorts of themes. Therefore, upstream engagement can benefit from analyzing the data they provide. Netnography, a methodological approach that applies ethnographic methods to the context of online communities [18], provides a research methodology that can help to analyze such data. In the following, we explain netnography in the context of social media and explain how this approach is relevant for upstream engagement.

### Netnography

Netnography is "a specialized form of ethnography adapted to the unique computer-mediated contingencies of today's social worlds" [19]. Netnography provides a five step approach that considers the specific requirements of online research [20]: First, the research questions are defined. Second, the community where the research should be applied is identified. In the following third step, data collection is carried out under ethical considerations. In the fourth step, the data is analyzed. Finally, the results of the research are presented to the public.

### Sentiment detection

In this research paper, we develop an approach to specify the data collection and analysis steps of netnography for upstream engagement in applying sentiment detection. Sentiment detection, as a form of text mining for identifying opinions and emotions towards entities in different sorts of texts [21], provides useful methods for analyzing comments in social media networks and has been successfully applied on various social media platforms such as Facebook [22] or Twitter [23]. Thus, sentiment detection can be considered as an appropriate method to analyze social media content for upstream engagement.

## 7.3 Development of a Systematic Approach

Upstream engagement can be used to explore people's feelings and develop "ideas, options and priorities" with the public [24]. For the purpose of including the feelings, ideas, options and priorities towards a certain type of technology into technology-related research, this paper proposes the following systematic approach for deriving design implications for a technology from its determinants for acceptance and rejection. By ‘acceptance’ we mean a positive attitude towards a technology, by ‘rejection’ a negative attitude. The approach follows the ‘typical’ procedure of sentiment detection, but without focusing on its technical/algorithmic implementation.

**Step 1 – Selecting suitable Facebook posts for a type of technology in one or more relevant application fields:** Choose posts on Facebook which provide appropriate content and comments. Select such posts which address relevant stakeholders, have a high number of comments, are published by reputable platforms and are rather neutral and not polemical.

**Step 2 – Categorizing comments into acceptance, rejection, and neutral stance/no opinion:** Collect all comments of the posts you have selected and assign them in whole or in part to one of the three categories.

**Step 3 – Extracting the reasons for acceptance and rejection:** Go through all statements of both the acceptance and rejection category and, if any, extract the reason mentioned for accepting or rejecting the type of technology.

**Step 4 – Clustering the extracted reasons:** Go through all reasons you have extracted and build clusters.

**Step 5 – Identifying determinants for acceptance and rejection:** Determine the core of the clusters you have built. For the designation of the clusters, we recommend to take acceptance theories from the field of Information Systems into account, which contain ‘classical determinants’ such as “ease of use” or “usefulness”.

**Step 6 – Deriving design implications:** Find design requirements which meet the determinants for acceptance of the technology and oppose the determinants for rejection.

An example to illustrate the approach is given in table [9]:

**Step 1:** Post by ‘Cambridge English’: “Some people say that virtual reality will change education. What do you think? How do you think virtual reality will change language learning?” (22 comments)

**Step 2:** Comment: “I believe virtual learning resources are in and are rather helpful (-> acceptance) but nothing can replace a good teacher. I have studied different languages and I have used virtual studying devices just as a mere complement but always have turned to my teacher (-> rejection)”.

**Step 3:** Reason for acceptance: “virtual learning resources are in”; “are rather helpful”; reason for rejection: “nothing can replace a good teacher, […] always have turned to my teacher”

**Step 4 & 5:** Determinant for acceptance: “current trend”, “usefulness”; Determinant for rejection: “Replacement of teacher”

**Step 6:** Design a useful virtual reality tool as a complement to existing teaching formats.

**Table 9: Example "Virtual Reality for Education"**

**Ethical issues of our approach**

When doing netnography, ethical issues have to be considered regarding data collection. For example, when collecting information from closed groups in online communities, it is unclear whether participants agree that their posts are used by researchers and are made available publicly. We solved this issue in this paper by only collecting data Facebook posts which are publicly available. However, when adopting our approach for other cases, ethical issues should be considered, e. g. through obtaining the consent of participants in closed communities.

### 7.4 The Exemplary Cases of ‘Virtual Reality’ and ‘Affective Technology’

To illustrate our proposed approach, we have applied it to ‘virtual reality’ (VR) and ‘affective technology’ (AT). By VR we mean a 360° virtual environment generated by a headset. VR technology is widely known due to reports on ‘Oculus Rift’ or ‘HTC Vive’. In contrast to VR, AT has not yet established itself in the consumer market and remains rather unknown to the general public. ATs are systems which can sense and/or generate human emotions (e.g. happiness, anger, fear). An affective learning system, for instance, could identify boredom or frustration and regulate its level of difficulty accordingly.

The entire data has been “manually” coded by the first two authors of this paper.

**Step 1:** For VR, we chose two application fields (game and health care) and three posts per application field. For each post, we coded up to 50 comments (in total 150 comments for game and 139 comments for health care). For AT, we selected three posts on emotion recognition technology across different application fields with 144 comments in total.

The main challenge of this step was to find appropriate posts which were not too polemical or political and encouraged multiple users to provide reasonable comments. Serious news organizations, such as CNN or the German news broadcast “Tagesschau”, proved to be the most promising providers of such posts, as they tend to report neutrally and have a high number of subscribers.

**Step 2:** In the second step, we categorized the comments into one or more of the three categories “acceptance”, “rejection” or “neutral”. As can be seen from Table [10], applying VR in the game context received the highest amount of acceptance and the lowest amount of rejection, followed by applying VR for health care. In contrast, the commentators are more cautious regarding AT which received less than half the amount of acceptance than the other two application fields and the highest amount of rejection. Notably, there was a high amount of neutral comments in all application fields, ranging from 71 neutral comments for VR for health care to 86 neutral comments for VR in the gaming context.

| | **acceptance** | **rejection** | **neutral** |
|---|---|---|---|
| VR/game* | 40 | 28 | 86 |
| VR/health care | 38 | 31 | 71 |
| AT | 18 | 41 | 85 |

*>150 because a comment can partly express acceptance and rejection

**Table 10: Results of Step 2 "Categorizing comments"**

Categorizing comments into acceptance and rejection requires a high amount of interpretation. Especially (supposedly) ironical comments were subject of discussions. If the first two authors could not agree on a comment, the third author decided. However, the vast majority of comments could be clearly categorized.

**Step 3:** In the third step, we extracted the reasons the commentators had for accepting or rejecting the respective technology. For VR in the gaming context, reasons for acceptance were brought up 38 times. In contrast, there were only 17 times that commentators mentioned reasons for accepting AT. When looking at reasons for accepting, the reverse picture emerges: For AT, reasons for rejection were mentioned 40 times, whereas they were only mentioned 29 times for each VR context. The results of step 3 are presented in Table [11].

| | **reasons for acceptance** | **reasons for rejection** |
|---|---|---|
| VR/game* | 38 | 29 |
| VR/health care | 21 | 29 |
| AT | 17 | 40 |

*<40 reasons for acceptance because an acceptance comment does not necessarily give a reason. But in contrast, a comment can give more than one reason (cf. rejection).

**Table 11: Results of Step 3 "Extracting reasons"**

Similar to step 3, identifying the reason for acceptance or rejection requires interpretation. To avoid losing valuable data, we decided to follow a rather generous interpretative approach. All sentences or terms which could potentially provide information on why a user expresses a certain opinion have been extracted.

**Step 4 & 5:** Since step 4 and 5 are strongly interrelated and are done iteratively, we have summarized both steps to one. We started by clustering all reasons we have collected and abstracting them into collective terms, which resulted in a list of determinants for acceptance and rejection per application field (shown in table [12]).

| | determinants for acceptance | determinants for rejection |
|---|---|---|
| VR/game* | future-orientation, usefulness, fun, curiosity, past experience, experiencing phantasies, physical activity, health | motion sickness, third party’s unfamiliarity, distance from reality, mental-related changes, social-related changes, ugly design, lacking maturity, distraction from other activities, fear of addiction |
| VR/health care | physical enhancement, mental enhancement, usefulness, curiosity, future orientation, familiarity | lacking usefulness, lacking understanding of functionality, lacking trust in media/functionality/ doctor, strain, technology hostility, motion sickness, addiction, high costs, time, fear, potential harm |
| AT | trust in functionality/ government/structural assurances, low costs, usefulness, just world beliefs, health, curiosity, social-related changes, physical enhancement, mental enhancement, technological advancement | lacking trust in functionality/government/manufacturer, lacking usefulness, high costs, surveillance, “sick” behavior, fear of addiction, cheaper substitute, technology hostility |

**Table 12: Results of Step 4 & 5 “Clustering & Identifying determinants”**

Certainly, the clusters and terms were not always clear-cut. That is why the first two authors had to discuss and find common solutions. Since the objective of this step is to find determinants for acceptance (and rejection), acceptance theories from the field of

Information Systems could help to build clusters and find collective terms. The technology acceptance model (TAM) [25] is a well-known example for an acceptance theory, which, for instance, could provide us the determinant of ‘usefulness’. However, these theories could not provide us any application field-specific determinants, which, in our case, are grounded in the data.

**Step 6:** In the final step, we derived design implications building upon the identified determinants from the previous steps. Table [13] exemplarily shows one design implication addressing selected determinants for acceptance and rejection for each of the application fields. For example, in the case of VR in the gaming context, a determinant for acceptance consisted of the possibility to experience phantasies in virtual reality games. Thus, a design implication that might be beneficial for a certain stakeholder (“fans of novels”) is using VR to bring phantasies alive (e. g. through adopting novels in a VR game). In contrast, a determinant for rejecting VR was called “expected social changes related to isolation”. To address this issue, VR games could be designed in a way that encourages – or forces – people to meet in reality in order to be successful in the game. In the context of AT, one determinant for accepting this technology was trust in structural assurances. A resulting design implication to foster acceptance could therefore be structural assurances in form of external safety structures (e. g. through laws that regulate the use of AT for companies). For commentators who rejected AT, surveillance was an important issue. Thus, a promising design implication might be to implement privacy in design through transparency and data avoidance.

| | **determinant** | **design implication** |
|---|---|---|
| VR/game | +experiencing phantasies | Use VR to bring phantasies alive (e.g. based on novels with a strong fan base) |
| | -social-related changes (isolation) | Meeting people in reality can be designed as a part of the game. |
| VR/health care | +physical enhancement | Use VR to teach doctors how to move correctly. |
| | - lacking understanding of/trust in functionality | The tool should provide sophisticated help and be designed “transparently” (what is it doing? which data does it collect? which dangers exist? etc.). |

| | | |
|---|---|---|
| AT | +trust in structural assurances | Provide the users of AT with external safety structures (e.g. regulations, laws, guarantees etc.). |
| | -surveillance | Do not forward information about the user or, if necessary, make transparent who gets which information. |

**Table 13: Results of Step 6 "Deriving design implications"**

Step 6, the translation of determinants for acceptance and rejection into design implications, highly relies on the technical and conceptual expertise as well as intuition of the persons conducting this step. However, we believe it to be important to include this step, since the main objective of RRI and upstream engagement is to make a significant impact on the outcome of research and innovation. Thus, the design implications should reflect for which purposes a technology is to be designed and which features and functions it should have.

### 7.5 Discussion

In this paper, we have proposed a systematic approach that makes use of Facebook comments for upstream engagement and applied it to three exemplary cases (VR for gaming, VR for health, and AT). Applying our method on the exemplary cases suggests that Facebook comments can be used to supplement upstream engagement, even though some hurdles still exist. Especially if a researcher of a design-oriented research project is interested in identifying feelings, ideas, options, and priorities from the public before having built a prototype, the approach proposed in this paper can be of help.

Considering the challenges of upstream engagement when integrating public actors into research activities, our developed approach exhibits several advantages compared to the ways upstream engagement is usually deployed. First, our approach comes with a tremendously reduced amount of effort. The researcher does not need to actively step into a dialogue with participants, lessening the methodological burden (e.g. the organization of interview appointments). Hence, the approach requires less temporal and monetary resources, representing economic advantages over other methods. Second, potential research subjects (i.e. public actors) do not need to be encouraged to unveil their opinions and thoughts on the topic of interest. They post them voluntarily and publicly via social media platforms and, thus, are intrinsically motivated to do so, requiring no further external incentives. This comes with the advantage that researchers can access a broad variety of opinions and discussions, which leads to multifaceted perspectives enriching the researcher's often narrow or very specific point of view. Additionally, the aforementioned tensions between the public and scientific domain can be (partly) relieved by getting closer to the people's real-world context.

Due to the flexible and efficient nature of our approach, it can be deployed at a very early stage of scientific projects. Thus, it allows quick adaptations and modifications of research activities and agendas. In addition to that, knowledge gathered via the approach at hand is able to serve as a "ground truth" researchers can build upon, legitimizing future initiatives.

However, our approach is not without limitations. First, the representativeness of social media users and especially commentators can be questioned. Nevertheless, this depends on the researchers' target group. Second, upstream engagement requires an intensive dialogue between research and public which the proposed method can only partly address. For example, a technology that is too new to be discussed in online communities could not be examined with our approach. However, most technologies are discussed rather early within relevant online communities, as the exemplary case of AT shows. Lastly, there are several comments that are not substantial or contain irony which might complicate the correct categorization of comments and extraction of reasons. Thus, one should be aware that the method of sentiment detection relies to some degree on subjectivity.

A final aspect that should be considered are ethical implications of the developed approach. It is important to note that, regarding ethical concerns such as privacy, the researcher has the responsibility to take care of ethical issues that might emerge from analyzing posts from closed communities or communities in which the commentators do not expect to be cited from. Additionally, stemming from the issue of a possible low representativeness from comments and social media sites, it is possible that not all stakeholders are taken into account through analyzing the comments. Thus, researchers should bear in mind that design implications resulting from this approach might be incomplete and that there might be stakeholders that should be addressed differently.

In conclusion, using Facebook is a promising approach for researchers who plan to apply upstream engagement and Responsible Innovation. Furthermore, our approach is especially useful in a very early stage of product development. This offers the opportunity to automate the approach with technical solutions from sentiment detection.

**Acknowledgements**

This article was supported by the projects INEMAS (No. 16SV7235) and ELISE (No. 16SV7512) funded by the German Federal Ministry for Education and Research (BMBF).

## 7.6 References

[1] Innovation in the Twenty-First Century. John Bessant. In: Responsible Innovation - Managing the responsible emergence of science and innovation in society. Richard Owen, John Bessant, Maggy Heintz. Wiley, p. 14, 2013.

[2] Midstream modulation of technology: governance from within. Erik Fisher, Roop L. Mahajan, Carl Mitcham. Bulletin of Science, Technology & Society, 26(6), 485-496, 2006.

[3] Strengths of public dialogue on science-related issues. Roland Jackson, Fiona Barbagallo, Helen Haste. Critical Review of International Social and Political Philosophy, 8(3), 349-358, 2005.

[4] The public value of science: or how to ensure that science really matters. James Wilsdon, Jack Stilgoe, Brian Wynne. Demos, p. 29, 2005.

[5] Public Attitudes to Science 2011. Jayesh Navin Shah, Sarah Castell. https://www.ipsos-mori.com/researchpublications/researcharchive/2764/Public-attitudes-to-science-2011.aspx

[6] Sentiment analysis and subjectivity. Bing Liu, In N. Indurkhya & F. J. Damerau (Eds.), Handbook of natural language processing. Chapman and Hall, 627–666, 2010.

[7] Netnography. Doing Ethnographic Research Online. Robert V. Kozinets. Sage Publications, 1, 2010

[8] Science blogs and public engagement with science: Practices, challenges, and opportunities. Inna Kouper. Journal of Science Communication, 9(1), 1-10, 2010.

[9] Innovation in the Twenty-First Century. John Bessant. In: Responsible Innovation - Managing the responsible emergence of science and innovation in society. Richard Owen, John Bessant, Maggy Heintz. Wiley, p. 14, 2013.

[10] Democratizing innovation: The evolving phenomenon of user innovation. Eric von Hippel. International Journal of Innovation Science, 1(1), 29-40, 2009.

[11] Strengths of public dialogue on science-related issues. Roland Jackson, Fiona Barbagallo, Helen Haste. Critical Review of International Social and Political Philosophy, 8(3), 349-358, 2005.

[12] What is an emerging technology?. Daniele Rotolo, Diana Hicks, Ben R. Martin. Research Policy, 44(10), 1831, 2015.

[13] Deliberative public engagement: nine principles. Diane Warburton, Lindsey Colbourne, Karin Gavelin, Richard Wilson, Anthony Noun. Background Paper. NCC National Consumer Council. Involve, London, p. 2, 2008. http://www.involve.org.uk/assets/Publications/Deliberative-public-engagement-nine-principles.

[14] Qualitative methods in organizational research: A practical guide. Nigel King. Template Analysis, 1998.

[15] Public Attitudes to Science 2011. Jayesh Navin Shah, Sarah Castell. https://www.ipsos-mori.com/researchpublications/researcharchive/2764/Public-attitudes-to-science-2011.aspx

[16] Responsible Innovation – Opening Up Dialogue and Debate. Kathy Sykes, Phil Macnaghten. In: Responsible Innovation - Managing the responsible emergence of science and innovation in society. Richard Owen, John Bessant, Maggy Heintz. Wiley, p. 87, 2013.

[17] Future challenges - https://www.publicengagement.ac.uk/explore-it/culture-change/future-challenges - Accessed 16/01/2017

[18] The Field Behind the Screen: Using Netnography for Marketing Research in Online Communities. Robert V. Kozinets. Journal of Marketing Research, 39(1), 61–72, 2002.

[19] Netnography. Doing Ethnographic Research Online. Robert V. Kozinets. Sage Publications, 1, 2010

[20] Netnography. Doing Ethnographic Research Online. Robert V. Kozinets. Sage Publications, 58-73, 2010

[21] Sentiment analysis and subjectivity. Bing Liu, In N. Indurkhya & F. J. Damerau (Eds.), Handbook of natural language processing. Chapman and Hall, 627–666, 2010.

[22] Sentiment analysis in Facebook and its application to e-learning. Alvaro Ortigosa, José. Martín, & Rosa M. Carro. Computers in Human Behavior, 31,527–541, 2014

[23] Efthymios Kouloumpis, Theresa Wilson and Johanna D. Moore. (2011). 'Twitter sentiment analysis: The good the bad and the omg!' Icwsm, 11(538–541), 164.

[24] Deliberative public engagement: nine principles. Diane Warburton, Lindsey Colbourne, Karin Gavelin, Richard Wilson, Anthony Noun. Background Paper. NCC National Consumer Council. Involve, London, 2008.

http://www.involve.org.uk/assets/Publications/Deliberative-public-engagement-nine-principles.

[25] User acceptance of computer technology: a comparison of two theoretical models. Fred D. Davis, Richard P. Bagozzi, & Paul R. Warshaw, Management Science, 35(8), 982-1003, 1989.

# 8 Design Requirements for Digitalized Healthcare Support

| | |
|---|---|
| Title | **Investigating Ethical Design Requirements for Digitalized Healthcare Support: The Case of Ambulatory Physiotherapeutic Assistance Systems** |
| Number | **P2** |
| Authors | Marius Müller[1]<br>Oliver Heger[1]<br>Björn Niehaves[1]<br><br>[1]University of Siegen<br>Kohlbettstraße 15<br>57072 Siegen |
| Publication Type | Conference Proceedings |
| Publication Outlet | Hawaii International Conference on System Sciences |
| Status | published |
| Full Citation | Mueller, M., Heger, O., Niehaves, B. (2018), "Investigating Ethical Design Requirements for Digitalized Healthcare Support: The Case of Ambulatory Physiotherapeutic Assistance Systems", 51st Hawaii International Conference on System Sciences (HICSS 51), Hawaii, USA. |

**Table 14: Publication Overview (P2)**

# Investigating Ethical Design Requirements for Digitalized Healthcare Support: The Case of Ambulatory Physiotherapeutic Assistance Systems

*Abstract*: Due to the advent of digitalized healthcare services and decentralized structures, the tele-medical support of therapeutic treatments is increasingly in the focus of researchers and practitioners. Here, systems offering an interface between patients and physicians emerge as a fruitful way to reduce clinical visits and, thus, increase patient satisfaction and health. Yet, research on requirements for such systems has largely focused on patients who are not able to fully grasp the issues associated with such technologies due to their novelty and the changes they entail. With this study, inspired by the Responsible Innovation framework, we investigate the case of an ambulatory physiotherapeutic assistance system. We conducted four focus group workshops involving experts from different domains in order to integrate multiple stakeholder perspectives and thereby explore system design requirements. Our findings indicate that patient autonomy, security, privacy, competence and socio-cultural aspects contain relevant technological implications, each involving multiple design requirements.

## 8.1 Introduction

Healthcare is increasingly supported by digital solutions, especially to assist medical laypersons in the implementation of therapeutic procedures. The medical informatics domain is gaining more and more attention since around the turn of the millennium. This scientific field puts effort into the examination of the effectiveness of medical systems and their potential to support therapeutic outcomes [9, 15]. Particularly the design of therapeutic assistance systems for medical laypersons raise questions about its ethical implications. Whereas traditional applications, such as an ERP system or an online communication tool, do not entail major threats to the physical well-being of its user, systems that assist therapists or patients in performing therapeutic activities can potentially cause serious harm to the user. For instance, immature technology functionalities or improper visual guidance can lead to deterioration of the therapy and physiological injuries [34]. This, in turn, can lead to uncertainties, a lowered self-efficacy or even mental stress since the own health is affected [26], overshadowed by the omnipresent risk of data leakage and privacy issues [1]. In addition to the question whether a system being potentially harmful for health is ethically acceptable, individuals have reservations when it comes to using it, which may lead to resistance against or rejection of the technology [28].

One special characteristic of the class of ambulatory therapeutic assistance technology is the area of tension involving different stakeholders and interests as well as new spatial and temporal settings. This calls for new investigations, especially from an ethical perspective addressing the different parties involved. The design of systems being implemented in unconventional settings (e.g. at home) in order to aid the patients' treatment routines comes along with two major issues: (1) Due to the systems' novelty and the explosiveness of their purpose (i.e. patients' health and quality of life), most patients cannot rely on experiences when it comes to assessing design requirements and technical features. (2) Designing, developing and evaluating such a system incorporates a highly heterogeneous structure of stakeholders, not only within the group of patients but also within the groups of developers, physicians and therapists, scientists, health insurances, relatives and more. Their insights are able to inform a knowledge base for future research and contribute to a multifaceted examination.

With regard to these issues, the field of Responsible Innovation (RI) provides a promising framework for integrating ethical implications of technology into the design process. The objective of RI is the ethical acceptability, sustainability, and societal desirability of research and innovation [37]. It calls for the involvement of stakeholders in the design process as well as the orientation towards normative anchor points such as human health [37]. It furthermore demands anticipative activities in the design process to analyze intentional and unintentional consequences of an innovation for identifying ethical problems as early as possible [25]. In order to explore the ethical design of therapeutic assistance systems and taking RI into account, we aim to anticipate ethical implications of the assistance system from three different expert perspectives (developer, scientist, physician) as a starting point of our design process and, from that, to derive suitable design requirements. The reason we focus on expert perspectives as a first step is that their field and technical expertise allows us to begin with exploring, comprehending and anticipating realistic technological implementations before confronting patients with reasonable scenarios, benefits and harms. Hence, our study is guided by the following research questions (RQs):

**RQ1:** *Which ethical implications of a therapeutic assistance system can be anticipated from relevant expert stakeholder perspectives?*

**RQ2:** *Which design requirements can be derived from these ethical implications?*

## 8.2 Related Work

### 8.2.1 Assistance Systems in Healthcare

Research on medical assistance systems with a focus on therapeutic support is rather scarce in the IS domain. To date, much research has been conducted investigating tele-medical systems, which are able to interface patients and physicians, fostering a de-centralized healthcare structure. Here, parallels between the domains of medical informatics, Human Computer Interaction (HCI) and IS can be detected, for instance with regard to the development and design of healthcare systems [15]. One major research stream deals with the development of electronic health records, enabling physiotherapists to store patient data in a mandatory structured manner and share the data with other healthcare providers of the patient [8]. Implementing such information systems makes vital information accessible for the patients and, thus, serve as an interface between clinical and home environments [15]. In this vein, Chae et al. [9] conducted a study on the effectiveness of tele-medical systems. Major findings indicate that they can lead to less clinical visits and higher patient satisfaction regarding the medical treatment, fostering an economic and efficient way of healthcare support. Complementary, Alaiad and Zhou [2] empirically investigated factors constituting the user adoption of smart home healthcare systems promoting a ubiquitous health support. Their results indicate that expected effort and life quality as well as social influence affect the patient's intention to use such a system. Research largely unveiled important factors influencing the technological effectiveness and the adoption by the user.

Nevertheless, with specific regard to the development of physiotherapeutic assistance systems, Haux [18] identified several challenges that need to be addressed by researchers in the future. A major challenge is constituted by the digitalized therapeutic interventions, which should come along with as little strain on the patient as possible. Additionally, providing crucial and extensive information to the patient as well as enabling rigor documentation of the therapy process – involving multiple applications and exercises performed by the patient – and associated knowledge represent important issues that need to be tackled. With these challenges in mind, looking at digitalized therapy support from an ethical point of view seems promising, since the individual needs, expectations, and concerns of the patient play a major role in the design process.

To that end, multiple studies on ethical challenges and issues in the design process of ambulatory healthcare systems have been conducted. For instance, with regard to mHealth technologies, the importance of user feedback and the accompanying subjectivity due to individual value-systems and preferences has been shown [5]. Within the context of stay-at-home patients and their relations to caregivers, empiricism unveiled interpersonal tensions, which can occur in the home setting due to counteracting values, needs and expectations [7]. Apparently, many studies in the context of ambulatory therapy assistance focus on empirical and evaluative investigations with the patient as the unit of analysis. Since the case at hand incorporates an area of tension, which involves many actors (patients, caregivers, physicians, etc.) and settings (home, clinic, practice), the matter calls for supplementary methods aiming at a more holistic view, which is able to surpass tensions caused by uncertainty and subjective points of view. In order to address the ethical aspects of system design systematically and deliberatively, the Responsible Innovation approach represents a suitable theoretical and methodological lens, since it explicitly integrates perspectives of relevant stakeholders.

### 8.2.2 Responsible Innovation

RI assumes that technology is not only technically but also socially and politically constituted and therefore suggests that scientists, funders, innovators, and others share a collective political responsibility [33]. RI calls for a "transparent, interactive process by which societal actors and innovators become mutually responsive to each other with a view to the (ethical) acceptability, sustainability and societal desirability of the innovation process and its marketable products" [36] (p. 9). Within the RI framework, the anticipatory dimension requires methodologies that enable foresight to surface issues and explore impacts that may otherwise remain uncovered [25]. RI is applied across many different engineering and social sciences including the fields of IS and healthcare. In a study on ethical implications of emerging technology, innovative technological features such as "detailed understanding of the user", "autonomy", or "power over the user" have shown to be very significant from an ethical point of view and relate to ethical issues such as privacy, trust, liabilities, and digital divides [31]. The IS community is therefore called upon to engage more in ethical discourses around new technology [32]. Based on a demand for more critical research in IS, Stahl et al. [30] argue that focus groups as a method of data collection can contribute to the field of IS. With regard to healthcare, RI calls for proactive actions by a variety of stakeholders to address ethical and social implications of new technologies in healthcare to shape the innovation landscape [10]. Based on the findings of three focus groups comprising, inter alia, hospital managers, industrial designers, and medical device manufacturers, a study identified a variety of health care system challenges that technological innovation could help address [12]. The study states that anticipation needs to pay attention to the varying contexts of use in health organizations and home. Developers need to remain open to the views of others, and to be responsive to new knowledge and values, proving the applicability of the method within our study.

## 8.3 Methodological Approach

### 8.3.1 Research Design

***Case study research.*** The context of our study is highly explorative and context-specific. Since little research has been done on the class of assistance systems under investigation, a case study research design investigating the dynamic setting at hand was deemed valuable and promising [13]. We aim for insights on context-related system design within a transdisciplinary spectrum of perspectives, needs, requirements and expectations. Hence, our case involves experts from different domains.

***Focus group approach.*** For the explorative purpose of our case study, we conducted a qualitative focus group approach. The aim of a focus group investigation is to assemble a group of chosen individuals and collect data through group interaction and discussion on a given topic from personal experience [22, 24, 30]. Focus groups as a qualitative research method are highly underutilized in the IS domain [24, 30]. Nevertheless, they exhibit multiple strengths and advantages. According to O'hEocha et al. [24], focus groups direct attention to a specific topic just like interviews, but also facilitate discussion and, hence, emergence of consensus as well as conflicts. Furthermore, within a short period, researchers are able to collect rich data such as "attitudes, feelings, beliefs, experiences, and reactions in a way that is not feasible using other field methods" [30] (p. 4). Group discussion helps in increasing depth of data due to the surfacing of opinions, ideas and concerns that would otherwise not be externalized. Interactions can fill knowledge gaps and facilitate a better understanding through stimulating idea association and recall, helping the participants to quickly arrive at a common understanding of the given topic [15, 30]. Hence, focus groups are suitable for investigating unexplored and emerging topics such as assistance systems design for therapeutic and health purposes, since this methodology is already established in the healthcare domain [15, 21].

***Case description and usage scenario.*** A heterogeneous, multidisciplinary group with differing values, means, judgments and opinions constitutes the sample participating in the study. All of the participants take part in a national research project on the development of a therapeutic assistance system and are experts in their respective field. The project representing our case deals with the demonstrative development of a mobile system, which is capable of assisting physiotherapeutic treatments, particularly the Vojta therapy. This therapy can give access to elementary movement patterns of patients with an impaired central nervous system by applying a stimulus on the patient's body, which evokes automated movements. Here, three initial usage scenarios represent the baseline for further investigations. First, the patients' caregivers are able to utilize the system and receive visual and contextual aid in performing treatments with the patient, for instance, in case of severe immobilization of the patient. The ambulatory character of the system enables them to be spatially independent, facilitating a smaller amount of clinical visits and less face-to-face time with the therapist. Second, the system can work as a control tool, capturing and analyzing the therapeutic movements. The therapist or physician can utilize the data to optimize the therapeutic process, which can lead to quicker and possibly stronger results regarding the patients' health and the effectiveness of treatments by laypersons. Third, the system can serve as a training tool within the education of future therapists by providing fundamental teaching content and treatment guidance.

Currently, the system assembles a combination of software modules, such as user interface and movement analysis algorithms, as well as hardware components. The latter cover depth cameras, body sensors, and pressure plates that are able to measure the patient's movements in a non-clinical environment, for instance, at home. The aforementioned usage scenarios and the technical set-up form the workshops' basis for discussion.

### 8.3.2 Data Collection and Analysis

We carried out four moderated focus group sessions engaging a sample of 19 experts. To organize the sessions and allow theoretically driven concepts to emerge, we followed a two-step approach consisting of an initial (focus group 1) and subsequent data collection phase (focus groups 2 to 4), paired with iterative data analysis. The first session aimed to explore ethical implications of the system development open-mindedly, thus, addressing RQ1. The three subsequent sessions cover investigations on system requirements based on the initial findings, answering RQ2.

The initial session, engaging 19 participants, was a heterogeneous "full group" workshop [17] involving multiple disciplines, each fulfilling different roles in the development process, i.e. medicine, technical development, IT consulting and social and computer sciences. The participants were about equally distributed across the disciplines. The session took 120 minutes. The workshop was executed in four phases: (1) The moderator gave an introduction on ethical issues related to technology design in order to sensitize the participants for topics beyond "traditional" ones such as security. (2) The three usage scenarios and the technical status-quo was provided to achieve a common starting point. (3) Each participant was asked to write down up to five ethical issues and design challenges that come to mind. (4) The individual results were presented and discussed in plenary. This way, we achieved an interdisciplinary discussion encouraging the experts to think beyond their disciplines. The results were captured in the form of written notes being attached to a whiteboard and categorized by content related similarities. For instance, one category dealt with privacy and data security issues that are inherent in the requirement engineering phase of a health support system dealing with highly personal data such as bio-signals and physical markers (e.g. blood pressure, heart frequency or oxygen level). After the workshop, a set of major themes was derived from the data within a first data analysis iteration (see Table [15]). The theme construction was done by iteratively clustering the notes from the first workshop in order to identify underlying requirements representing the gathered ethical aspects of the system design.

Ethical issues with regard to patient intimacy and privacy as well as security issues such as effective data loss prevention and an appropriate access control to sensible data (e.g. diagnosed disease(s), medication, therapy progress) form the theme of Privacy and Security (T1). The Autonomy theme (T2) involves issues with regard to the extent of control a user has during the therapeutic application, the freedom of choice in going alternative routes (e.g. more convenient, less hurtful treatments) as well as the trustworthiness of the system assistance functionality. Competence (T3) refers to the development of therapeutic skills regarding the treatment and the prevention of competence reduction due to a high amount of digital assistance. The latter hereby can be caused by increasing user dependence on system support, exploiting the user's natural learning curve. The fourth theme Design for All (T4) deals with socio-cultural and demographic aspects of the system design. These involve issues such as proper handling of the system by the elderly or people with less computer knowledge as well as categorically excluding other groups from using the system due to certain characteristics (such as disembodiment, poverty or skin color).

| **Theme** | **Definition (self-phrased)** |
|---|---|
| T1: Privacy & Security | The degree to which the system safeguards the user's privacy and protects data from unauthorized access. |
| T2: Autonomy | The degree to which the user is able to autonomously control the system behavior during a therapy session. |
| T3: Competence | The degree to which the system utilization preserves or increases the individual competence of the user. |
| T4: Design for All | The degree to which the system is designed for a heterogeneous population (e.g. age, gender, culture). |

**Table 15: Emerging Themes**

Subsequently, we enriched the set of themes with literature [27]. This served the purpose of (1) gaining a deeper understanding of the respective phenomenon and (2) achieving a higher degree of bibliographic connectivity. Since the uncovered themes have already been examined within other contexts, we utilized this knowledge and included it in the following focus group sessions guiding the moderated discussions as additional input. By this, we were able to foster the major themes and gain insights on how they behave in the specific context of ambulatory physiotherapeutic assistance systems. Table [16] shows the theoretical integration of our interim results.

| Theme | Theoretical Link(s) |
|---|---|
| T1 | Threat avoidance [22]; Privacy calculus [19]; Control over personal data [6] |
| T2 | Perceived Behavioral Control, Computer anxiety [14] |
| T3 | Job effectiveness and performance changes [16]; Dependency and extent of use [20] |
| T4 | Digital Divide [23] |

**Table 16: Theoretical Integration of Themes**

Following the initial data analysis and its theoretical integration, we designed three subsequent focus group sessions based on the initially gained insights. We followed a "mini group" design [17], for which each workshop took about 90 minutes and involved a small, homogenous group belonging to a dedicated discipline (see Table [17]), exhibiting a shared space of meaning and understanding. Hereby, we aim to gain detailed insights from specific perspectives, enriching our data across disciplines and antagonizing narrow, possibly biased statements.

| Session | Discipline | # |
|---|---|---|
| FG1 | Heterogeneous (see above) | 19 |
| FG2 | Technical development and consulting | 7 |
| FG3 | Research (computer and social sciences) | 6 |
| FG4 | Healthcare (physicians and therapists) | 6 |

**Table 17: Focus Group Constellations**

Each of the three workshops consisted of four cycles covering the emerged themes. Each theme (T1 to T4) was handled separately. Here, one cycle dealing with one theme consisted of (1) theme definition and refinement, (2) requirement derivation and definition by each participant, (3) collective sighting of requirements, identifying parallels and conflicts, and (4) exploring possible technological implementations. The order of themes during the workshops was randomized in order to antagonize possible negative effects such as fatigue during the sessions. We integrated the results and insights from a workshop within the subsequent ones, fostering a theory-driven emergence of data. This structured format exhibits a high moderator input [24], leading to comparable and consistent, yet context-bound results. Data was collected in the form of digital audio recordings and ensuing transcription, written in vivo protocols prepared by one of the authors as well as index cards written by the individual participants. This led to three distinct (i.e. one per workshop) sets of design requirements addressing the formerly identified themes.

Analyzing the data was performed in two deductive steps: (1) Each cycle within a single workshop session (representing one particular theme) was analyzed separately, leading to a specific set of subthemes. (2) Afterwards, we looked for correlations, similarities and occurring dissonances between these identified subthemes and those from the other two workshops, leading to an aggregated list of subthemes for each of the four themes T1 to T4 across disciplines.

## 8.4 Findings

In the following, we present the four emerged themes, each involving several subthemes, representing concrete requirements, and thus relating to RQ2. The quotations given below were translated into English analogously with minor adjustments regarding grammar and syntax and preserving the statement's meaning. Each statement represents the consensus within the respective group.

### 8.4.1 Privacy and Security

***Openness and Connectivity***. In order to foster a high degree of user privacy, security of personal data as well as intimacy, according to the professionals from the medical domain, the system can be treated as a closed environment, comparable to a traditional patient record. "*Patient data is filed in a medical record, which is closed [for others]. We would handle this data like every other information, for instance, like EKG pictures. We would not make any exceptions here. It would be a closed system, which would make an application-based system difficult. The data must not land in any cloud. The system should not have an internet connection at all. [...] Removing the data from the building [the clinic] is not allowed.*" (FG4) Furthermore, the responsibility over the data lies with the individual patient, for instance, "*the patients may take their x-ray images home with them at any time.*" (FG4)

***Data Storage.*** This subtheme deals with how the system can handle different incurring forms of measurement data. A developer suggested to withdraw raw material such as video data which shows the patient and instead analyze these files on the fly. "*We should avoid storing videos and pictures of the patient. Which means I analyze the incurring data, look at the results, and withdraw the original data. Basically, the need for this data is no longer existent. [...] Let us say you get a feedback in the form of green, yellow, and red signals, the treatment was okay or not okay. I would only use the video data to capture the movements. [...] We should delete this data once we did our analysis.*" (FG2) This requirement lies in the vein of data economy, only storing highly abstract measurement data (e.g. frequency of movements) that cannot be attributed to a specific person. "*The movements and the accuracy can be analyzed and visualized, but pictures of the actual body are not saved*." (FG3)

***Simulation.*** As an alternative to the subtheme above, the simulation of movement data which uses an abstract, humanoid model emerged as a way of storing (originally) personalized data. Since, for instance, video material can be useful later on when *"[...] looking at the measurement data and comparing it to what actually happened in the video*" (FG2), simulation can de-personalize data: "*In case the patient does not want to capture a video, you can simulate the movement information using some human or skeletal model. Others will see a mapped model hiding the patient's identity. Another option might be to blur or hide some body portions like the face, which are not essential to capturing the movements*." (FG3)

***Transparency***. This subtheme covers the system feature of achieving awareness of the patient towards the ongoing technological processes such as data capturing, analyzing, and storing. A computer scientist suggested that "*the system might show some notifications on the user interface, such as what the software algorithm is currently capturing and evaluating. [...] So the user gets feedback on what the system is doing right now and what kind of data incurs.*" (FG3) The users could dynamically negotiate whether they want to produce specific sets of data in order to preserve their individual privacy. With regard to this, a technical developer mentioned the capability of turning system features on and off manually and autonomously: "*The user should be able to turn every feature on and off, for instance, the storage and transfer of incurring data. You [the user] should be able to configure different scenarios within the system with regard to data security. Do you want to store video data? If yes, shall it be stored centrally?*" (FG2) In contradiction to the "*closed system*" mentioned above, the open nature here does not tackle unauthorized access by externals but the transparent and flexible implementation of system features.

### 8.4.2 Autonomy

***Voluntary Use.*** With regard to user autonomy, the participants from the medical domain attached importance to the voluntariness of the system usage itself. On this general level a therapist stated: "*If you want to be captured with regard to your movements, you turn it [the system] on and vice versa. Easy decision. You do not have to use it. There are no disadvantages in doing so. However, there are some advantages such as comparing your handles to the ideal ones and, thus, increasing the treatment quality at home and feeling more confident. You can consider it a supportive offer, but not mandatory*." (FG4) This defines the purpose of the system, which is complementary and less restraining.

***Individualization.*** In order to retain the users' potentials regarding the treatment itself, the system should allow individual approaches and handles during a therapy session. According to a developer, this can be done by initially setting up specific goals of the therapy session. "*You can ask the user. What do we want to achieve? So you can tell the system that you want to accomplish this by your own and in case you are wrong, the system can inform you automatically or by user inquiry. [...] Predefining the exact procedure lowers the potential. People will say 'that is wrong, I would rather proceed like this'*." (FG2)

***Data Interpretability.*** Enabling individual interpretations of captured data during the therapy session emerged as a subtheme. A physician mentioned the pulse oximeter (a clip attached to the patient's finger measuring the oxygen saturation of the blood) as a representative example: "*The range [of the saturation] is from 0 to 100%, values under 90% are naturally bad, so the oximeter gives a signal when the value drops lower. However, in case of premature babies, values like 91% are normal and it can drop to 86% sometimes. In this case, there is no health risk, so the parents adjust the alarm limit to 85%. [...] You get a feeling for how to adapt the alarm to the real situation*." (FG4) It becomes evident that the interpretation of the system outputs lies with the user. "*The system cannot make decisions regarding the real meaning of the measurement results. [...] Only the doctor can do that, looking at the individual patient's situation. [...] In turn, this can lead to more user independence and confidence*." (FG4) This degree of freedom however can affect the therapy progress, thus, suitable control mechanisms need to be implemented.

***Access Authority.*** With regard to the extent of access certain user groups have to the system settings and configurations, this subtheme suggests to look at different levels of authority. The participants mentioned implementing both a detailed and broader access as well as a rather limited one. The former addresses therapists and physicians, being able to configure individual option sets for the patients, leading to the latter access mode. "*The therapist should have a more generic level of access to the software settings, whereas the patients have a more limited access because they are not that versed in medical issues.*" (FG3) Furthermore, the expert, after performing an initial, user-individual setup, can adjust the system periodically in collaboration with the patient, which in turn can positively affect the patient's trust in the operating principles of the technology. "*The system should be adjusted within the clinic for the first time. [...] In the first meeting, the therapist and the patient can choose the features together. [...] In the next meeting, they can adjust the settings in case the patient feels uncomfortable with the way the system works.*" (FG3) This comes along with a certain degree of visibility with regard to the available options and features, lowering a potential information overload and simplifying system handling: "*You do not need to show the user all available options and features of the system.*" (FG3)

### 8.4.3 Competence

***Accuracy.*** During the different cycles exploring the competence theme, the accuracy issue emerged as a major subtheme across all disciplines. On the one hand, the experts from the medical domain demand a very high degree of accuracy when it comes to measuring, documenting and analyzing movements during a treatment session. For instance, one therapist stated that *"[...] it is an absolute mandatory criterion having a high [movement] detection rate of 99% and above so that it makes any sense. Otherwise, it is just a gimmick.*" (FG4) On the other hand, a computer scientist working on the pattern recognition algorithm (FG3) mentioned that an accuracy level of 85 to 90% would be a satisfactory and targetable goal from a technical point of view. Here, according to a physician, this comparably low accuracy does not satisfy the proper digitalization of an established therapeutic treatment model, since "*we have a very complex diagnostic and treatment model, which we developed over decades and is working very well with regard to the patient care. If you are measuring superficially [...] and cannot represent the complexity [...] you may have something very plausible [and efficient] but do not satisfy the diagnostic and therapeutic possibilities.*" (FG4) The system can be "*fascinating and efficient*" but rather inaccurate. Thus, it still requires the profound competence of an expert.

***Level of Expertise.*** Another major subtheme discussed throughout the workshops is constituted by the different degrees of competence and knowledge the user groups (i.e. physicians, therapists, patients and caregivers) have. Whereas newcomers, apprentices and laypersons lack certain skills regarding the therapeutic treatment, experts often have huge pools of knowledge at their disposal and, throughout the years, have developed individual treatment procedures beyond the textbooks. One physician for instance claimed a high degree of adaptability: "*Our novices use a copied note when they are on the station, because they cannot memorize the content of the examination, yet. We, the experienced ones, already stored this sheet on our internal hard drive, so I perform only the steps that I need. […] The digital [examination] catalogue wants to be processed, so does it take away my variability [and flexibility]?*" (FG4) According to many participants, this issue can be tackled through the implementation of different modes, i.e. a training mode providing detailed information during the treatment and an expert mode, in which the system only sporadically supports the user with meaningful information without giving linear guidelines. "*Within a training system, there could be a visualization you can look at, which is guiding you. In the next step [i.e. mode] the visuals are turned off and there is only a signal when doing the handles. Within the high-level version, the system is inactive and only reacts in case of treatment errors*." (FG2) Alternatively, the support system could only be active periodically in order to antagonize a loss of competence: "*It would be a good thing to run through the process without any kind of automatization, […] having temporal intervals where the therapists only [treat by themselves].*" (FG2)

***Feedback.*** According to the developers and researchers, different forms of user feedback can be a promising way to maintain and build competence. To foster a certain degree of awareness, the system should provide both instant and long-term feedback. Whereas the latter rather serves a documentary purpose, instant feedback is able to efficiently support the treatment session. Here, subliminal forms of feedback stem useful. "*The feedback should not consist of graphical elements. It could be a sound or a light signal, so that the person is still involved in the activity […] and does not have to look at a monitor. This at most could be used for instruction purposes. Minimalistic visualization*." (FG2) Auditory signals have the advantage of a higher reproducibility: "*When I am looking at the display and want to reproduce the rhythm [of movements], I do not have a pattern the brain can memorize. In case of the sound, I am feeling it. We have to reproduce that*." (FG2)

***Coexistence.*** Several workshop participants from different domains mentioned that the system most likely could not function without any sort of manual input by a human being involved in the actual treatment. Hence, the user and the system mutually assist each other with respect to their capabilities. "*We cannot say 'just take the system, apply to every patient and always get* *the exact results'. I think the major competence needed is to manually give certain inputs such as 'this is how it has to look like and this is the expected outcome for this particular patient'.*" (FG3) Hence, the system cannot substitute the expert guiding the therapeutic treatments. "*We have to look on both sides. We will take the knowledge from the therapist and the data from the system. We have to make an intersection to figure out whether they make the same decisions*." (FG3) A therapist states, *"[...] we can help the system to classify the movement measurements and the system can assist us in capturing and documenting the movements of the patient.*" (FG4)

### 8.4.4 Design for All

***Accessibility.*** One subtheme emerging throughout the workshop sessions deals with the design and implicit marketing concept of the system. In order to achieve a high degree of accessibility by a broad population, the participants suggest different ways of implementation. "*If you design a system any user can access, for instance, by using his or her smartphone and a dedicated software application, you will increase the generality and the number of potential users because many people own a smartphone these days*." (FG3) However, this solution comes with difficulties as well: "*There is some trade-off. Imagine the scenario of an elderly person not owning a modern smartphone. For that person, we could provide some device like a tablet, running only one application with easy navigation and pairing itself automatically with the rest of the system.*" (FG3) A dedicated hardware device, in turn, is most likely affiliated with greater costs. Nevertheless, the financial health insurance support represents a possible route: "*In case the system is very expensive but exhibits a high value with regard to the rehabilitation quality and efficiency, the public community [i.e. health insurance] will most likely pay for that*." (FG4) Hence, delivering a high benefit to the healthcare system could facilitate the financing of the system and make it more accessible to the public. "*If we can spread the costs over many people, using the system remains attractive for all.*" (FG2)

***Guidance.*** As mentioned above, intuitive and easy to learn controls can render the system more accessible and usable for certain user groups. With regard to the necessary degree of usability, according to some participants, it can be helpful to renounce given freedom and autonomy of the user for the sake of a more streamlined guidance. "*Closely related to user autonomy, in case an elderly person has difficulties using the system, the system can be configured accordingly, so the user is automatically led by the system [during the treatment]*." (FG3) The same can hold true for potential users with low computer skills: "*Usability should be ensured for less technologically affine people*." (FG2)

***Data Heterogeneity.*** The last subtheme is constituted by the set of various kinds of data the system generates. In order to address the beliefs, values and expectations of a broad variety of potential users with regard to defining characteristics such as culture, religion, demographics and appearance, the participants stated that the system should not rely on a single mandatory data source but on many. With regard to a camera system capturing patient movements, a computer scientist stated: "*I can imagine to set up sensory features including color information and non-color information, for instance depth information or skeletal information. There are many features [of the patient's body] the system would be able to classify, regardless for instance the patient's skin color.*" (FG3) Hence, the individual user could have the freedom to choose amongst different data sources without limiting system functionality.

### 8.5 Discussion

The findings of our study, representing the initial step within the ethically driven case of an ambulatory therapeutic assistance system, indicate several contributions for both theory and practice, motivating further investigations and (design) theory building.

***Implications for theory.*** The paper is able to contribute to the body of knowledge regarding the ethically driven research on ambulatory therapeutic systems. Since the systems most likely change temporal and spatial settings and the way therapies are performed, our findings shed new light on already known factors. In order to achieve system adoption and acceptance, de-centralized patient-generated data requires new privacy concepts such as discarding original data and simulate it generically. Second, the degree of user autonomy raises the question on how much freedom the user should have, since actions may stand in conflict with the therapist's specifications. Besides allowing individual usage scenarios, the interpretability of system outputs complements our understanding of user autonomy. Third, fostering and utilizing individual skills represents a major challenge, since an inaccurate therapeutic treatment support can lead to serious health issues. The construct of user competence, in this case, consists of both computer efficacy and therapeutic knowledge. With these theoretical implications, the findings of our study simultaneously contribute to ethical implications of new technologies in healthcare, which the field of Responsible Innovation calls for [10].

***Implications for practice.*** Our results represent technical requirements, which developers of therapeutic healthcare technologies are able to implement within ambulatory systems aiming to interface practitioners and their patients. For instance, our results call for new ways of on-the-fly data analysis mechanisms, parallelizing treatment and examination and superseding the storage and transfer of sensible data. Here, modern pattern recognition algorithms promise efficient ways of data analysis [38]. This also addresses the given limitations regarding internet connectivity and openness of the system. Additionally, our results indicate that developers should have the coexistence of human and technology in mind. Implementing ways of mutual assistance while respecting the user's expertise and tacit knowledge represents a promising way of maintaining or even promoting individual skills and user confidence. Here, so-called exergames combining gaming elements and physiological exercises provide a promising technology, allowing the user different ways to fulfill the treatment goal [3, 29]. Subsequently, developers should consider the hardware and software configuration when designing a therapeutic assistance system. For the sake of accessibility, an application-based support using consumer technologies (e.g. smartphones), contrary to common expectations, can lead to excluding groups of patients in need, calling for innovative and cost-efficient visualization devices [4, 34].

***Limitations.*** The qualitative case study approach exhibits certain weaknesses. For instance, case studies may produce insights that are very detailed yet lack a superordinate perspective. Findings are prone to be idiosyncratic and rather narrow, hampering the ability to raise the generality of the gained insights and derived concepts [13]. Additionally, the sample of the case shared membership within a project. Underlying common goals can lead to biases and suppress 'out of the box' thinking. Furthermore, there are mentionable cons of using focus groups as a data collection method. Group interactions during the session can lead to conformity of views and opinions, which are predefined by dominant characters in a group and lack reproducibility [35].

***Future work.*** Since this study is designed as an initial step within a system design process, focusing on experts, several future research opportunities arise. First, the conduction of semi-structured interviews with patients and caregivers seems promising, illuminating complementary perspectives. This enables a Between-Method-Triangulation [35] of findings aiming at an integrative, domain-spanning design concept, gaining deeper and more comprehensive insights on the ethically legitimized construction of ambulatory therapeutic assistance systems. This method enables integrative conclusions, leading to the promotion of knowledge production [11, 35]. Second, the emerging system concept enables the derivation of (normative) design hypotheses, which can be analyzed with quantitative methods (e.g. surveys or lab experiments).

***Acknowledgements.*** This research article was supported by the SenseVojta project granted by the German Federal Ministry of Education and Research (BMBF) (No. 13GW0166E).

## 8.6 References

[1] M. Al Ameen, J. Liu, and K. Kwak. 2012. “Security and privacy issues in wireless sensor networks for healthcare applications”. Journal of medical systems, 36(1), pp. 93-101.

[2] A. Alaiad, and L. Zhou. 2015. “Patients' Behavioral Intentions toward Using WSN Based Smart Home Healthcare Systems: An Empirical Investigation”. In 48th Hawaii International Conference on System Sciences (HICSS), pp. 824-833.

[3] G. Alankus, A. Lazar, M. May, and C. Kelleher. 2010. “Towards customizable games for stroke rehabilitation”. In Proceedings of the CHI Conference on Human Factors in Computing Systems, pp. 2113-2122.

[4] S. Ananthanarayan, M. Sheh, A. Chien, H. Profita, and K. Siek. 2013. “Pt Viz: towards a wearable device for visualizing knee rehabilitation exercises”. In Proceedings of the CHI Conference on Human Factors in Computing Systems, pp. 1247-1250.

[5] M. Barry, K. Doherty, J. Marcano Belisario, J. Car, C. Morrison, and G. Doherty. 2017. “mHealth for Maternal Mental Health: Everyday Wisdom in Ethical Design”. In Proceedings of the CHI Conference on Human Factors in Computing Systems, pp. 2708-2756.

[6] F. Bélanger, and R. E. Crossler. 2011. “Privacy in the digital age: a review of information privacy research in information systems”. MIS quarterly, 35(4), pp. 1017-1042.

[7] A. B. Berry, C. Lim, A. L. Hartzler, T. Hirsch, E. H. Wagner, E. Ludman, and J. D. Ralston. 2017. “How Values Shape Collaboration Between Patients with Multiple Chronic Conditions and Spousal Caregivers”. In Proceedings of the CHI Conference on Human Factors in Computing Systems, pp. 5257-5270.

[8] R. Buyl, and M. Nyssen. 2009. “Structured electronic physiotherapy records”. International journal of medical informatics, 78(7), pp. 473-481.

[9] Y. M. Chae, J. H. Lee, S. H. Ho, H. J. Kim, K. H. Jun, and J. U. Won. 2001. “Patient satisfaction with telemedicine in home health services for the elderly”. International journal of medical informatics, 61(2), pp. 167-173.

[10] G. Christie. 2017. “Progressing the health agenda: responsibly innovating in health technology”. Journal of Responsible Innovation, pp. 1-6.

[11] D. DeLuca, M. J. Gallivan, and N. Kock. 2008. “Furthering information systems action research: a post-positivist synthesis of four dialectics”. Journal of the Association for Information Systems, 9(2), p. 48.

[12] O. Demers-Payette, P. Lehoux, and G. Daudelin. 2016. “Responsible research and innovation: a productive model for the future of medical innovation”. Journal of Responsible Innovation, 3(3), pp. 188-208.

[13] K. M. Eisenhardt. 1989. “Building theories from case study research”. Academy of management review, 14(4), pp. 532-550.

[14] C. Elie-Dit-Cosaque, J. Pallud, and M. Kalika. 2011. “The influence of individual, contextual, and social factors on perceived behavioral control of information technology: A field theory approach”. Journal of Management Information Systems, 28(3), pp. 201-234.

[15] G. Eysenbach. 2000. “Consumer health informatics”. British Medical Journal, 320(7251), p. 1713.

[16] P. N. Finlay, and A. C. Mitchell. 1994. “Perceptions of the benefits from the introduction of CASE: an empirical study”. MIS quarterly, pp. 353-370.

[17] Greenbaum, T. L. 1998. The handbook for focus group research. Sage.

[18] R. Haux. 1997. “Aims and tasks of medical informatics”. International journal of medical informatics, 44(1), pp. 9-20.

[19] Z. Jiang, C. S. Heng, and B. C. Choi. 2013. “Privacy concerns and privacy-protective behavior in synchronous online social interactions”. Information Systems Research, 24(3), pp. 579-595.

[20] S. Kang, K. H. Lim, M. S. Kim, and H. D. Yang. 2012. „A Multilevel Analysis of the Effect of Group Appropriation on Collaborative Technologies Use and Performance”. Information Systems Research, 23(1), pp. 214-230.

[21] R. Koppel, J. P. Metlay, A. Cohen, B. Abaluck, A. R. Localio, S. E. Kimmel, and B. L. Strom. 2005. “Role of computerized physician order entry systems in facilitating medication errors”. Jama, 293(10), pp. 1197-1203.

[22] H. Liang, and Y. Xue. 2009. “Avoidance of information technology threats: a theoretical perspective”. MIS quarterly, pp. 71-90.

[23] B. Niehaves, and R. Plattfaut. 2014. “Internet adoption by the elderly: employing IS technology acceptance theories for understanding the age-related digital divide”. European Journal of Information Systems, 23(6), pp. 708-726.

[24] C. O'hEocha, X. Wang, and K. Conboy. 2012. “The use of focus groups in complex and pressurised IS studies and evaluation using Klein and Myers principles for interpretive research”. Information Systems Journal, 22(3), pp. 235-256.

[25] R. Owen, J. Stilgoe, P. Macnaghten, M. Gorman, E. Fisher, and D. Guston. 2013. “A framework for responsible innovation”. In Responsible innovation: managing the responsible emergence of science and innovation in society, pp. 27-50.

[26] A. H. Pollack, U. Backonja, A. D. Miller, S. R. Mishra, M. Khelifi, L. Kendall, and W. Pratt. 2016. “Closing the Gap: Supporting Patients' Transition to Self-Management after Hospitalization”. In Proceedings of the CHI Conference on Human Factors in Computing Systems, pp. 5324-5336.

[27] Ryan, G. W., and H. R. Bernard. 2000. Data management and analysis methods.

[28] B. Samhan. 2017. “Patients’ Resistance towards Health Information Technology A Perspective of the Dual Factor Model of IT Usage”. In Proceedings of the 50th Hawaii International Conference on System Sciences.

[29] J. D. Smeddinck, M. Herrlich, and R. Malaka. 2015. “Exergames for physiotherapy and rehabilitation: a medium-term situated study of motivational aspects and impact on functional reach”. In Proceedings of the ACM Conference on Human Factors in Computing Systems, pp. 4143-4146.

[30] B. C. Stahl, M. C. Tremblay, and C. M. LeRouge. 2011. “Focus groups and critical social IS research: how the choice of method can promote emancipation of respondents and researchers”. European Journal of Information Systems, 20(4), pp. 378-394.

[31] B. C. Stahl, G. Eden, and M. Jirotka. 2013. “Responsible research and innovation in information and communication technology: Identifying and engaging with the ethical implications of ICTs”. Responsible innovation, pp. 199-218.

[32] B. C. Stahl, G. Eden, M. Jirotka, and M. Coeckelbergh. 2014. „From computer ethics to responsible research and innovation in ICT: The transition of reference discourses informing ethics-related research in information systems”. Information and Management, 51(6), pp. 810-818.

[33] J. Stilgoe, R. Owen, and P. Macnaghten. 2013. “Developing a framework for responsible innovation”. Research Policy, 42(9), pp. 1568-1580.

[34] R. Tang, X. D. Yang, S. Bateman, J. Jorge, and A. Tang. 2015. “Physio@ Home: Exploring visual guidance and feedback techniques for physiotherapy exercises”. In Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems, pp. 4123-4132.

[35] Von Kardorff, E., I. Steinke, and U. Flick. (Eds.). 2008. Qualitative Forschung: Ein Handbuch. Rowohlt Taschenbuch-Verlag.

[36] R. Von Schomberg. 2011. „Towards responsible research and innovation in the information and communication technologies and security technologies fields”.

[37] R. Von Schomberg. 2013. “A vision of responsible research and innovation”. In Responsible innovation: Managing the responsible emergence of science and innovation in society, pp. 51-74.

[38] A. J. Young, L. H. Smith, E. J. Rouse, and L. J. Hargrove. 2014. “A comparison of the real-time controllability of pattern recognition to conventional myoelectric control for discrete and simultaneous movements”. Journal of neuroengineering and rehabilitation, 11(1), p. 5.

# 9 Exploring Design Dimensions through Value Sensitive Design

| | |
|---|---|
| Title | **Exploring Ethical Design Dimensions of a Physiotherapeutic mHealth Solution through Value Sensitive Design** |
| Number | **P3** |
| Authors | Marius Müller[1]<br>Oliver Heger[1]<br>Björn Niehaves[1]<br><br>[1]University of Siegen<br>Kohlbettstraße 15<br>57072 Siegen |
| Publication Type | Conference Proceedings |
| Publication Outlet | Americas Conference on Information Systems |
| Status | published |
| Full Citation | Mueller, M., Heger, O., Niehaves, B. (2018), “Exploring Ethical Design Dimensions of a Physiotherapeutic mHealth Solution through Value Sensitive Design”, 24th Americas Conference on Information Systems (AMCIS 2018), New Orleans, USA. |

**Table 18: Publication Overview (P3)**

# Exploring Ethical Design Dimensions of a Physiotherapeutic mHealth Solution through Value Sensitive Design

*Abstract*: With the advent of smartphones, wearable sensors, and health tracking devices, mobile technologies providing healthcare services increasingly interfere with the users' daily routines. In particular, mHealth solutions enable spatially independent health assessment and therapy monitoring, resulting in more efficient treatments and less clinical visits. However, due to these technologies being highly interwoven with the patient's everyday life, mHealth technology designers need to factor in individual values and attitudes towards health-related technologies. In this paper, we propose a Value Sensitive Design approach for the design of a digital assistance for physiotherapeutic treatments. We present a three-step-approach comprising focus groups, narrative and semi-structured interviews, and design workshops with relevant stakeholders to develop a system design that supports human values. First empirical findings suggest that autonomy, competence, privacy and diversity are key values forming the baseline for future work.

*Keywords*: Value Sensitive Design, mHealth, Sensor-based Systems, Therapy Support, Mixed Methods

## 9.1 Introduction

mHealth systems such as mobile rehabilitation solutions for treating patients at home are receiving increasing attention (Tang et al. 2015). When the patient's condition requires ambulatory treatment, therapy interferes with the everyday life of individuals and their peers. Much research has been conducted within design-oriented disciplines exploring and evaluating technological designs of assisting healthcare systems from the user perspective (Noble 2015). However, especially in the private life context of users, human values underlying the use of mHealth technologies remain rather unexplored. Following the ethical stream of design-oriented disciplines, Berry et al. (2017) state that "[u]nderstanding patients' values is key to the provision of high quality patient-centered care" (p. 1). Evidently, human values gain a major momentum regarding medical practices (Kelly et al. 2015) and digitalized support of healthcare services. Design processes are not value-neutral (Friedman et al. 2013) and require a sensitive design-lens.

Friedman et al. (2013) define a value as “what a person or group of people consider important in life” (p. 2). Values depend on the needs of individual human beings. In this vein, health is a fundamental value. Contrary to the context-specific, situative importance of values, many studies on digital health systems have been conducted within artificial settings neglecting the strong influence real-life settings have on the way patients manage their conditions (Berry et al. 2017). Healthcare comes with different sets of values, demands and concerns. The context of professionalized healthcare services and private life exhibits frictions between (1) different stakeholders (e.g. physicians and patients) and (2) value systems with regard to wellbeing, quality of life and therapeutic efficiency and effectiveness. This implies a high need for normative considerations. A promising methodological framework for investigating individual and context-dependent value systems is Value Sensitive Design (VSD) (Friedman et al. 2002, 2013). VSD aims for identifying human values within the context of a specific technology. It provides tools to systematically identify and analyze stakeholders, their respective value systems and ways to transform the normative insights into design choices and system features (Friedman et al. 2002, 2013). The case study presented in this paper proposes conceptual, empirical and technical investigations as suggested by VSD. The investigations take place within a project on the development of an ambulatory, sensor-based system intended to assist physicians and caregivers within clinical and home settings. The purpose of this study is to identify stakeholders and pursued values in order to identify value conflicts between stakeholder groups and values. Based on these conflicts, concrete design requirements and guidelines can be elaborated aiming for solving the conflicts. We propose the following research questions:

**RQ1:** *What constitutes the heterogeneous value-systems forming the normative conceptualization of ambulatory mHealth systems for physiotherapeutic purposes from different stakeholder perspectives?*

**RQ2:** *What design implications for the technological development of ambulatory mHealth systems for physiotherapeutic purposes can be derived from the unveiled value systems?*

## 9.2 Theoretical Background

### 9.2.1 Ethically driven healthcare systems design

The design of healthcare technologies demand ethical considerations, since they address fundamental intrinsic human values such as health and well-being. In particular, due to the advent of mobile technologies, mHealth systems increasingly interfere with the patients' everyday routines, effecting their perceived health status and quality of life (Kreps 2017). In contrast, designers are prone to impose their own values when making design choices, which in turn might stand in conflict with the patients' value systems, calling for ethical pluralism (Barry et al. 2017). The need for ethical considerations within design processes has already motivated many researchers to conduct dedicated studies on the interplay of values and technology (Knobel and Bowker 2011; Shilton et al. 2013). Barry et al. (2017) report on ethical design activities of a mHealth self-reporting app to support pregnant women with depression, fostering psychological well-being. Berry et al. (2017) explored values around the collaboration between patients with chronic conditions and their caregivers in an ambulatory setting. Research demands "perspectives that draw more attention to the local values [and the] highly heterogeneous user groups" (Barry et al. 2017) (p. 3). Many design techniques have been developed accounting for values in design, for instance reflective design and participatory design (Barry et al. 2017). Beyond that, Value-Sensitive Design (VSD) (Friedman et al. 2002, 2013; Friedman and Kahn Jr 2003) is a promising methodology to address value issues by identifying stakeholders, values, occurring conflicts, and design choices contributing to solving these issues.

### 9.2.2 Value Sensitive Design

The VSD approach is appropriate to illuminate ethical issues for sensor-based mHealth solutions for physiotherapeutic purposes. VSD is a methodology unveiling human values underlying the usage of IT. It enables developers to implement identified values within technological design decisions by prioritizing features to satisfy the stakeholders' interests. VSD has been applied within studies on digital healthcare, leading to concrete designs. Research areas amongst other cover patient self-management (Dadgar and Joshi 2018), ageing support (Detweiler and Hindriks 2012), and cyber-physical systems (Denning et al. 2014). However, the healthcare domain lacks value-sensitive studies on supporting therapeutic treatments by laypersons at home. This context involves many stakeholders and value conflict potentials, hence calling for appropriate design guidelines.

VSD suggests three forms of investigations. Conceptual investigations seek to identify relevant stakeholders (e.g. users, designers, society) and the respective values these stakeholders hold, resulting in an initial conceptual value set. Hence, this step covers "philosophically informed analyses of the central constructs and issues under investigation" (Friedman et al. 2002) (p. 2). Commonly, this can be done by adapting the value classification scheme developed by Friedman and Kahn (2003), which involves a set of "human values with ethical import", each holding distinctive relevance when it comes to IT design (Deng et al. 2016; Friedman and Kahn Jr 2003). Empirical investigations focus on the human context. The goal is to empirically investigate human reactions to and opinions on an artifact (Deng et al. 2016; Friedman et al. 2002, 2013). The way people prioritize values when it comes to using a certain technology is of major interest during the design process, since favored values can be implemented over others (Friedman et al. 2002). Technical investigations seek to elaborate technological designs that incorporate the previously identified and empirically refined values. Developers can retrospectively evaluate and modify existing technologies. Also, technical investigations allow for a more proactive design of system properties by deriving design requirements from values (Friedman et al. 2013). However, the re-organization of these steps seems reasonable. Empirical investigations are suitable for exploring prevalent values within the user's context, which inform further conceptual and technical investigations (Le Dantec et al. 2009). Conceptual activities are prone to import preconfigured values in order to align further research activities (Le Dantec et al. 2009). Closely related, researchers have suggested moving away from sole solutionism, which is intended to produce tangible outcomes (e.g. a user interface). Instead, highly explorative and unbiased investigations of users' values and real-life contexts promise deeper insights motivating further design considerations (Le Dantec et al. 2009). Within our study, we begin with explorative empirical investigations to avoid the potential induction of bias and import of pre-conceptions.

## 9.3 Methodological Approach

### 9.3.1 Case Description

The study at hand is part of a research project on the development of a sensor-based assistance system, aiming for supporting physiotherapeutic treatments following the Vojta principle. This therapy is applied to patients with a malfunctioning central nervous system (CNS), often resulting in an impaired locomotor system. By stimulating the patient's CNS through the application of pressure to defined body zones (reflex locomotion), the therapist tries to provide access to elementary movement patterns (e.g. standing upright). The therapeutic treatment has additional effects on the patient's body such as an altered blood pressure and breathing, which implies novel ways of sensory measurement techniques. Three usage scenarios form the foundation of the project: (A) Caregivers (here: parents) perform therapeutic treatments on the patients (here: infants) at home, since the treatment needs to be applied daily, rendering steady clinical visits unfeasible. The system aims to support these ambulatory treatments by providing contextual feedback regarding the treatment execution (e.g. appropriate advice), based on data (e.g. sensory data). (B) The utilization of hardware (e.g. acceleration sensors) allows for a detailed capturing of movements and physiological data. Its analysis enables the measurement of quality and quantity of treatment sessions. This enables the therapist to control the therapy progress more effectively, potentially accompanied by higher patient compliance. (C) The guidance of therapy sessions is suitable for educational purposes, representing a teaching and training tool for apprentices. Regarding these scenarios, different stakeholders have been identified, i.e. caregivers, physicians and therapists, and apprentices. To address these usage scenarios, the values within each group need to be analyzed.

### 9.3.2 Research Agenda

The case study presented in this paper comprises three sequential steps: (1) An exploration phase comprising focus group sessions engaging technological, medical, social and computer science experts. The goal is to unveil an initial set of ethical issues as well as correlating values and possible conflict-resolving design approaches. (2) A subsequent empirical phase incorporating narrative and semi-structured interviews with caregivers to investigate the user's context (especially at home), individual value systems and normative assessments. This step also delivers system requirements with regard to desired and unwanted features. The phase concludes with a triangulation of the qualitative data. (3) A conclusive design-oriented phase in which concrete design features and system properties are elaborated within focus group sessions and specified based on the values found. The three steps are briefly described below, followed by interim findings from the focus group study we conducted to date (Mueller et al. 2018).

**Explorative focus groups.** As a first step, we conducted four focus group workshops engaging 19 expert stakeholders from relevant domains (i.e. IT development, medicine, social and computer sciences). We carried out an initial workshop in order to discuss ethical challenges and questions regarding the design of the mHealth system, leading to initial values and potential designs. Subsequently, we conducted three workshops, each incorporating a subset of the stakeholders from one specific domain. The goal was to enrich each value by focused, multi-perspective discussions and iterative data analysis. This resulted in an integrated scheme covering four main values and respective subcategories (Mueller et al. 2018). Data analysis was performed in two steps: (1) Each value discussion cycle within a single workshop session was analyzed independently, resulting in a set of subthemes. (2) We analyzed similarities and dissonances between the subthemes. The interim findings are briefly described below.

**Narrative and semi-structured interviews.** We propose a second phase involving empirical investigations illuminating the patient-sided context. The goal is to develop a holistic value scheme covering multiple relevant perspectives. We plan to conduct interviews consisting of both open-ended and semi-structured questions (Deng et al. 2016). Open-ended questions aim for externalizing individual narratives and inherent values, asking the interviewees about everyday life situations, their handling of the condition, and salient feelings, needs and concerns. Semi-structured questions seek to explore the digitization of the treatment regarding the mHealth system aiding the caregivers at home and the benefits or trade-offs coming with it. This structured part of the interviews involves pre-conceptions on possible technological ways of supporting the treatment in order to circumvent a possible lack of imagination due to the absence of experiences relating to mHealth systems. The interview procedure resembles an indirect approach by asking interviewees about everyday life situations encompassing the values to be unveiled (Friedman et al. 2013). By that, researchers avoid priming the participants with pre-conceptualized values and enable people to explore the context in a differentiated and open-minded way. For data analysis, we adopt the coding procedure by Deng et al. (2016). The procedure involves three steps: (1) Each researcher codes every interview independently. (2)

The researchers discuss their codes and occurring disagreements. (3) Each researcher re-codes the interview data according to the elaborated scheme.

**Design-oriented focus groups.** Within the third phase, we plan to conduct focus group sessions consisting of design-oriented workshops with the purpose of unveiling concrete design features and system properties that are able to support identified values. While particularly engaging design and IT experts (e.g. interaction designers), we will use the triangulated findings as a basis for discussion and design elaboration. This approach relates to the technical investigations within VSD, as it seeks to proactively construct novel ways to address human values (Friedman et al. 2013). The data analysis will be performed in two steps comprising (1) the analysis of each workshop session and (2) the analysis of similarities and dissonances.

### 9.4 Interim Findings and Future Work

Four key values emerged from analyzing the initial focus group workshops, forming a superordinate value-system (Mueller et al. 2018), which incorporates the following: Autonomy: The degree to which the user is able to autonomously control the system behavior during a therapy session. Competence: The degree to which the system utilization preserves or increases the individual competence and skill level of the user. Privacy: The degree to which the system safeguards the user's privacy and protects data from unauthorized access. Diversity: The degree to which the system is designed for a heterogeneous population.

For each value, we derived technical manifestations that exhibit concrete implications for future system design (Mueller et al. 2018). Each manifestation represents a system feature that supports the respective value within the technology. For instance, Individualization (autonomy) describes a system property offering different forms of guidance according to the user's preferred level of autonomy during the treatment. Low levels of guidance allow individual approaches, such as personal treatment paths that work best for the user. With regard to competence, different forms of Feedback (e.g. audio, video, haptic) during the treatment can lead to higher levels of competence and confidence on the side of the user. For example, subliminal feedback (e.g. vibration of a body-worn device) can lower the level of distraction of the user, increasing the focus during the treatment and learning potential. Simulation (privacy) describes how data captured by the sensors can be visualized and stored, for instance by utilizing a generic, humanoid model instead of real video footage. Hence, sensible data can be obfuscated in accordance with to the user's privacy settings. Data Heterogeneity (diversity) implies the system's ability to capture multiple data via distinct sensors, enabling a broader population to use the system while not relying on a single source measurement. For example, the patient's physiology (e.g. in case of amputation) does not lower the system functionality.

The study proposed contributes to the body of knowledge in the field of mHealth technology design for assisting physiotherapeutic treatments at home. The values to be identified represent the complexity of multiple desires and interests of relevant stakeholders, which have to be considered when designing technical solutions. The design features to be derived pave the way for future technology development and evaluation. From a practical point of view, the inclusion of values as additional goals of mHealth technology design can lead to innovative design solutions to improve user experience and technology acceptance. Our next steps are threefold: (a) Conduct interviews engaging caregivers as potential future users of the mHealth system, (b) triangulate the empirical data from the focus groups and interviews in order to construct a holistic value-system, (c) elaborate concrete design principles through focus group workshops.

### Acknowledgements

This research article was supported by the SenseVojta project granted by the German Federal Ministry of Education and Research (BMBF) (No. 13GW0166E).

## 9.5 References

Barry, M., Doherty, K., Marcano Belisario, J., Car, J., Morrison, C., and Doherty, G. 2017. MHealth for Maternal Mental Health: Everyday Wisdom in Ethical Design, ACM Press, pp. 2708–2756.

Berry, A. B. L., Lim, C., Hartzler, A. L., Hirsch, T., Wagner, E. H., Ludman, E., and Ralston, J. D. 2017. How Values Shape Collaboration Between Patients with Multiple Chronic Conditions and Spousal Caregivers, ACM Press, pp. 5257–5270.

Dadgar, M., and Joshi, K. D. 2018. "The Role of Information and Communication Technology in Self-Management of Chronic Diseases: An Empirical Investigation through Value Sensitive Design," Journal of the Association for Information Systems (19:2), pp. 86–112.

Deng, X., Joshi, K. D., and Galliers, R. D. 2016. "The Duality of Empowerment and Marginalization in Microtask Crowdsourcing: Giving Voice to the Less Powerful through Value Sensitive Design," Mis Quarterly (40:2), pp. 279–302.

Denning, T., Kramer, D. B., Friedman, B., Reynolds, M. R., Gill, B., and Kohno, T. 2014. CPS: Beyond Usability: Applying Value Sensitive Design Based Methods to Investigate Domain Characteristics for Security for Implantable Cardiac Devices, ACM Press, pp. 426–435.

Detweiler, C., and Hindriks, K. 2012. “Value-Sensitive Design Patterns for Pervasive Health Care,” in 2012 IEEE International Conference on Pervasive Computing and Communications Workshops, March, pp. 908–913.

Friedman, B., and Kahn Jr, P. H. 2003. “Human Values, Ethics, and Design,” The Human-Computer Interaction Handbook, pp. 1177–1201.

Friedman, B., Kahn Jr, P. H., Borning, A., and Huldtgren, A. 2013. “Value Sensitive Design and Information Systems,” in Early Engagement and New Technologies: Opening up the Laboratory, Springer, pp. 55–95.

Friedman, B., Kahn, P., and Borning, A. 2002. “Value Sensitive Design: Theory and Methods,” University of Washington Technical Report, pp. 02–12.

Kelly, M. P., Heath, I., Howick, J., and Greenhalgh, T. 2015. “The Importance of Values in Evidence-Based Medicine,” BMC Medical Ethics (16:1).

Knobel, C., and Bowker, G. C. 2011. “Values in Design,” Communications of the ACM (54:7), p. 26.

Kreps, G. L. 2017. “The Relevance of Health Literacy to MHealth,” Information Services & Use (37:2), pp. 123–130.

Le Dantec, C. A., Poole, E. S., and Wyche, S. P. 2009. “Values as Lived Experience: Evolving Value Sensitive Design in Support of Value Discovery,” in Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, ACM, pp. 1141–1150.

Mueller, M., Heger, O., and Niehaves, B. 2018. Investigating Ethical Design Requirements for Digitalized Healthcare Support: The Case of Ambulatory Physiotherapeutic Assistance Systems, in Proceedings of the 51st Hawaii International Conference on System Sciences.

Noble, P. J. 2015. Resilience Ex Machina: Learning a Complex Medical Device for Haemodialysis Self-Treatment, ACM Press, pp. 4147–4150.

Shilton, K., Koepfler, J. A., and Fleischmann, K. R. 2013. “Charting Sociotechnical Dimensions of Values for Design Research,” The Information Society (29:5), pp. 259–271.

Tang, R., Yang, X.-D., Bateman, S., Jorge, J., and Tang, A. 2015. Physio@Home: Exploring Visual Guidance and Feedback Techniques for Physiotherapy Exercises, ACM Press, pp. 4123–4132.

# 10 Investigating Value Conflicts through Value Sensitive Design

| | |
|---|---|
| Title | **Health at any Cost? Investigating Ethical Dimensions and Potential Conflicts of an Ambulatory Therapeutic Assistance System through Value Sensitive Design** |
| Number | **P4** |
| Authors | Marius Müller[1]<br>Oliver Heger[1]<br><br>[1]University of Siegen<br>Kohlbettstraße 15<br>57072 Siegen |
| Publication Type | Conference Proceedings |
| Publication Outlet | International Conference on Information Systems |
| Status | published |
| Full Citation | Mueller, M., Heger, O. (2018), "Health at any Cost? Investigating Ethical Dimensions and Potential Conflicts of an Ambulatory Therapeutic Assistance System through Value Sensitive Design", 39th International Conference on Information Systems (ICIS 2018), San Francisco, USA. |

**Table 19: Publication Overview (P4)**

# Health at any Cost? Investigating Ethical Dimensions and Potential Conflicts of an Ambulatory Therapeutic Assistance System through Value Sensitive Design

*Abstract*: Technologies are able to support patients at home, empowering them to perform and monitor therapeutic exercises in a temporally and spatially independent way, promising health-related benefits such as higher therapy efficiency and less clinical visits. However, these systems increasingly interfere with everyday life, generating potential frictions with the values pursued by patients and thus calling for responsibility in technological design. We propose a Value Sensitive Design study on the development of a digital assistance for physiotherapeutic treatments at home. In order to factor in ethical aspects within the design process, we conducted focus groups and interviews with relevant stakeholders. We identified twelve values and six conflict potentials between values and stakeholders. We discuss our insights in the light of potential technological designs to account for values and the resolution of emerged conflicts. We conclude by providing limitations to our study, implications for theory and practice, and future research opportunities.

*Keywords*: Value Sensitive Design, Value Conflicts, Stakeholders, Ambulatory Therapy Support, Sensor-based Systems, Mixed Methods

## 10.1 Introduction

Innovative mobile technologies such as rehabilitation support systems which patients can use at home in order to improve therapy effectiveness are receiving more and more attention (Tang et al. 2015). Usage settings, in case the patient's condition requires a post-clinical or ambulatory treatment, increasingly shift into the everyday life of individuals and their peers. In this context, new opportunities and obligations arise for scientific studies. Whereas much research has been conducted within design-oriented disciplines (e.g. Human Computer Interaction) exploring, analyzing, and evaluating technological designs of assisting healthcare systems in a user-centered manner (e.g. Noble 2015), the simultaneous emergence of an ethical and humanistic approach can be found. Especially in the private life context of users, human values underlying the execution of prescribed exercises, the use of innovative technologies as supporting tools, and the preceding design and evaluation of such technologies are rather unexplored, calling for forthcoming research agendas (Rennick-Egglestone et al. 2016).

Following the humanistic stream of a highly salient technological dispute within design-oriented disciplines, Berry et al. (2017) state that "[u]nderstanding patients' values is key to the provision of high quality patient-centered care" (p. 1). Evidently, human values and norms receive a major momentum regarding medical practices (Kelly et al. 2015) and the digitization of healthcare services, creating decentralized structures and ambulatory treatment paths. In particular, life-spanning chronic medical conditions inherently demand "a biopsychosocial, evidence-based, patient-centered approach" (Vranceanu et al. 2009). In order to support human values that are involved in modern treatment scenarios and technology use, design processes must not be seen as value-neutral (Barry et al. 2017; Friedman et al. 2013), thus requiring a value-sensitive design-lens (Rennick-Egglestone et al. 2016).

Friedman et al. (2013) define a value as "what a person or group of people consider important in life" (p. 2). Values, thus, highly depend on the interests and needs of each individual human being, forming a subjective phenomenon rooted within a human's lifestyle, pursued norms, and priorities in life. In this vein, health represents a major fundamental value (Spiekermann 2015). In contrast to this context-specific, situative importance and salience of values, many studies on digital healthcare and therapy support have been conducted within artificial settings such as laboratory environments (e.g. Aggarwal et al. 2017). In doing so, they might not be able to capture the strong influence real-life settings and circumstances have on the patients, the struggles they may encounter, and the way they manage their conditions respectively on a daily basis (Berry et al. 2017; Huang et al. 2014). The complexity of human values appears to be higher in situ than in controlled settings (Miller et al. 2007). The latter might even lead to an altered behavior compared to "natural" behavior and situational assessment (Harrison et al. 2007). Hence, when it comes to investigating the design and adoption of healthcare systems, a call for studies examining real-life contexts, which provide authentic and highly situative values, becomes apparent (Huang et al. 2014; Miller et al. 2007).

Apparently, technologies for healthcare come with different sets of values, norms, demands and concerns compared to, for instance, convenience technologies addressing users' non-essential needs (e.g. entertainment). The hybrid context of digitized healthcare services and the patients' private life generates frictions between (1) different stakeholders involved (e.g. physicians, patients, and caregivers) and (2) accompanying value systems, predominantly covering wellbeing, quality of life, and the efficiency and effectiveness of treatments (see for instance Ballegaard et al. 2008). In this regard, a highly suitable methodological framework for unveiling, exploring and analyzing individual and context-dependent value systems regarding the use and acceptance of modern healthcare technologies is the Value Sensitive Design (VSD) approach (Friedman 1996; Friedman et al. 2002, 2013; Van den Hoven 2013). Based on conceptual, empirical and technical investigations, VSD aims to identify human values and norms within the context of a specific technology under development. VSD provides tools to systematically identify and compare different stakeholders, their respective value hierarchies, and ways to translate these normative insights into concrete, value-sensitive design features (Friedman et al. 2013).

The paper at hand presents a case study utilizing the VSD framework as a methodological lens. The study takes place within a national research project on the development of an ambulatory, sensor-based system, which is intended to assist physicians as well as patients and their caregivers in performing treatments following the Vojta principle, a physiotherapeutic concept being applied in cases of motoric impairment and demobilization. Commonly, this therapy is applied to infants, since they respond best to it and exhibit great chances of (partial) recovery (Bauer et al. 1992). The therapy and its digitization exhibit two main characteristics that call for ethical design investigations: (a) A vast spectrum of stakeholder perspectives and interests, and (b) the treatment of patients by laypersons (i.e. parents and caregivers) at home (Dirks and Hadders-Algra 2011). Accordingly, the goal of this study is to unveil relevant stakeholders and the values they pursue and to identify value conflicts that may occur between and within different stakeholder groups. The illumination and discussion of identified value conflicts further enable the elaboration of design requirements. The contributions of this paper might draw interest from (a) medical and IT experts seeking to develop and deploy technologies within therapeutic routines, and (b) researchers applying VSD and explorative approaches to health technology design. Hence, we propose the following research questions (RQs) guiding our research:

**RQ1:** *Which values does each stakeholder group pursue with regard to the development and usage of a sensor-based system supporting therapeutic treatments at home?*

**RQ2:** *Which conflicts arise across the values identified and how can they inform the system's design?*

To answer our research questions, we utilize an approach consisting of three sequential steps. (1) Explorative focus group sessions with experts from relevant domains that are involved within the development process in order to establish an initial set of values that are important from different expert perspectives and backgrounds; (2) Empirical investigations of patient-sided values utilizing narrative and semi-structured interviews with potential users (i.e. parents and caregivers) in order to gain deeper insights and a richer understanding of dominant, design-relevant values; (3) Evidence-based identification and discussion of value conflicts across all elaborated values and stakeholder groups. These conflicts facilitate the derivation of design requirements that are potentially able to solve the value frictions, leading to an acceptable and ethically grounded system design.

## 10.2 Theoretical Background

### 10.2.1 Ethical Design of Healthcare Technologies

The design and development of novel healthcare technologies for ambulatory therapy support naturally call for a high degree of ethical and normative sensitivity towards the future users, their habits, needs, concerns, and attitudes (Dadgar and Joshi 2018). Here, the users' attitudes relate to both, the therapy and accompanying behavior changes or limitations as well as the usage of IT for health reasons. In this regard, these emerging technologies support intrinsic human values such as health, well-being, and physiological or psychological recovery (Spiekermann 2015). Moreover, designers and developers to some extent are prone to impose their own values and prioritizations when making design choices and embedding concrete features within new technologies, which in turn often are contradictory to the patients' value hierarchies. Research, thus, calls for an ethical pluralism in order to widen the scope of technology design for health purposes (Barry et al. 2017).

The scientific need for ethically and normatively enriched design and development processes has already led to the conduct of many dedicated studies, following an extensive history of investigating the interplay of technology and human values (Friedman et al. 2013; Knobel and Bowker 2011; Shilton et al. 2013). Addressing and thus fostering the value of psychological well-being, Barry et al. (2017) report on the value-sensitive design of a mHealth self-reporting app intended to support pregnant women with depression. Amongst other, the voice and language used within the app to communicate with the users (i.e. patients) has been set to first-person in order to achieve a more personal and intimate interaction with the app, which can be traced back to the sensitive nature of psychological assessments. In the same vein, Berry et al. (2017) investigated how patients with multiple chronic conditions and their spousal caregivers collaborate at home and in everyday situations. The study deliberately focuses on values each of the two stakeholders pursues. Findings show how congruent values foster motivation and mutual support, whereas opposing values can lead to tensions and a perceived loss of autonomy. On a design level, these insights suggest new ways of communication and sharing individual opinions in order to overcome value asymmetries. Further, a study conducted by Rennick-Egglestone et al. (2016) deals with the technological support of recovery from mental health issues, utilizing computerized cognitive behavioral therapy (CCBT). When it comes to design, the authors suggest a focus on the sensitivity towards the patients' needs and values. For instance, conventional CCBT routines incorporate a static presentation of information, neglecting specific groups of users with temporary cognitive constraints, hampering the correct usage of the system and, thus, therapeutic progress. As a result, personalized and individual presentation formats incorporating a broader spectrum of stakeholders promises a more profitable usage. Within the domain of physiotherapy, Chandra et al. (2012) conducted a field study with musculoskeletal disorder patients performing exercises at home, exploring factors leading to non-compliance. Several patient-sided needs and concerns could be derived, representing value sets the patients pursue. In particular, patients stated a need for comprehension on how the exercises pursue therapeutic goals, which suggests designing easy to understand visualizations of the body and activated muscles.

Evidently, ethics have experienced an upturn within design-oriented domains. Whereas many researchers traditionally focus on the creation, exploration, and evaluation of technological artifacts, normative and ethically driven approaches constitute a research stream on their own (see for instance Berry et al. 2017 and Von Schomberg 2011). As shown above, value-sensitive investigations call for three aspects being important to making "good" design choices: (1) Values at stake (What to design for? What values are important?), (2) multiple stakeholder perspectives (Who to design for? Whose values are at stake?), and (3) ways to embed values within design (How to design? What features support identified values?) (Friedman et al. 2013; Van den Hoven 2013). Research points out a high demand for "perspectives that draw more attention to the local values of individual design cases and new approaches to ethical design that acknowledge the problem of highly heterogeneous user groups" (Barry et al. 2017) (p. 3). To date, many techniques have been developed and applied in order to align technical design with ethical aspects, for instance “reflective design”, “value conscious game design”, “participatory design”, and “value-sensitive co-design models” (Barry et al. 2017). However, with regard to the three aspects mentioned above, a complementary technique stands out, which is the Value Sensitive Design (VSD) methodology developed and refined by Friedman et al. (Friedman et al. 2002, 2013; Friedman and Kahn Jr 2003).

### 10.2.2 Value Sensitive Design and its Application

The VSD framework represents a methodology unveiling inherent human values and norms underlying the usage and adoption of an IT artifact. Subsequently, VSD enables developers to implement identified values within technological design decisions (Friedman et al. 2013), for instance by prioritizing certain features over others in order to satisfy a targeted normative design based on the users’ desires, concerns and interests (Van de Poel 2015). By providing dedicated iterative steps, VSD represents a methodological lens to address ethical issues by unveiling relevant stakeholder groups, their respective values, identifying and discussing occurring conflicts and asymmetries as well as finding ways design choices can contribute to solving them. Accordingly, “the effort involved is not just in establishing which values or whose values, but how they are expressed, promoted or even neglected, in other words, to what ends” (Barry et al. 2017) (p. 3). Hence, we deem VSD appropriate for illuminating the ethical issues underlying the case presented in this paper, which deals with the ambulatory utilization of a sensor-based, spatially independent solution for physiotherapeutic purposes.

VSD has been successfully applied within different studies on digital healthcare support, informing concrete design guidelines and, thus, empowering developers to consider patients’ values when making design choices. Areas of application cover patient self-management of chronic diseases (Dadgar and Joshi 2015, 2018), the utilization of robots within nurse-patient relationships (van Wynsberghe 2013), ageing support and care for the elderly (Detweiler and Hindriks 2012), and electronic health records (Simons and Verhagen 2008). Further, the implementation of healthcare information systems in rural areas (Walton and DeRenzi 2009) as well as cyber-physical systems in the form of wireless implantable medical devices (Denning et al. 2010, 2014) have been subjects within applied VSD research. Apparently, while conducted studies cover a broad spectrum of healthcare topics, the research domain lacks a value-sensitive and design-oriented investigation of digital support for physiotherapeutic treatments laypersons (i.e. parents) apply to the patients (i.e. infants and children) at home. Due to the abundance of stakeholders and conflict potential regarding differing value hierarchies, this area of healthcare needs to be explored and proper design guidelines have to be elaborated accordingly.

The VSD framework provides three iterative and intertwined steps, comprising conceptual, empirical, and technical investigations. Conceptual investigations seek to identify relevant stakeholders with a legit interest in the technology under construction (e.g. users, designers, society) and the respective values these stakeholders may hold from a philosophical perspective, resulting in an initial conceptual value set. Hence, this step covers "philosophically informed analyses of the central constructs and issues under investigation" (Friedman et al. 2002) (p. 2). Commonly, this can be done by adapting the value classification scheme developed by Friedman and Kahn, which involves a set of so-called "human values with ethical import", each holding distinctive relevance when it comes to IT design (Deng et al. 2016; Friedman and Kahn Jr 2003). Empirical investigations focus on the human context the technology is intended to be deployed in. The goal is to understand human reactions to and opinions on the artifact under development through the utilization of empirical methods (Deng et al. 2016; Friedman et al. 2002, 2013). The way people prioritize values when it comes to using a certain technology is of major interest during the design process, since favored values can be implemented over others (Friedman et al. 2002). For instance, the promotion of user privacy via less acquisition of personal data can outweigh the implementation of broad, personalized functionalities. Technical investigations seek to elaborate technological designs and concrete features that incorporate the previously identified and empirically refined values and concepts. On the one hand, developers can retrospectively evaluate and adapt existing technologies supporting targeted values while suppressing less prioritized values. On the other hand, technical investigations also allow for a more proactive design of novel features and system properties, in which prevailing values manifest (Deng et al. 2016; Friedman et al. 2002, 2013). Although these steps are highly interwoven through their iterative nature and mutual dependency, they can be distinguished by their unit of analysis. Conceptual investigations treat values as theoretical constructs, empirical investigations incorporate individuals, and technical investigations focus on the artifact which is being designed (Dadgar and Joshi 2018; Friedman et al. 2013). Hence, this distinction allows for separate, sequentially executed investigations.

However, from an ethical point of view, research suggests the re-arrangement of these steps. Empirical investigations are suitable for investigating values within the user's immediate context and environment, which motivate and inform subsequent conceptual and technical investigations (Le Dantec et al. 2009). Conceptual activities, on the contrary, are prone to import preconfigured values (as described in Friedman and Kahn Jr. 2003) into the context under investigation further research activities (i.e. empirical and technical ones) build upon (Le Dantec et al. 2009). It becomes evident that conceptual investigations, depending on the research context, should not precede empirical efforts. Researchers have suggested surpassing the common stance of solutionism, which seeks to produce tangible outcomes and IT artifacts (e.g. a user interface). Instead, unbiased empirical investigations exploring the users' value systems, real-life contexts, and everyday situations promise deeper insights (Le Dantec et al. 2009), providing a "holistic view of user experience that looks beyond the purposefulness of technologies" (Barry et al. 2017) (p. 1). These insights consequentially are able to motivate further design considerations (Le Dantec et al. 2009). In accordance with this revised stance, regarding the study at hand, we utilize explorative empirical investigations through a qualitative approach. We seek to avoid the potential induction of bias through imposing 'values of ethical import' and the resulting pre-definition of value sets.

## 10.3 Methodological Approach

### 10.3.1 Case Description

The VSD study presented in this paper takes place within a national research project on the design and development of a sensor-based system. The technical system is intended to support treatments following the so-called Vojta therapy, which is a physiotherapeutic treatment method developed by Vaclav Vojta in the nineteen sixties. The Vojta therapy is deployed in case the patient exhibits a malfunctioning central nervous system (CNS), which often times is accompanied by an impaired physiological posture and locomotor system, rendering the patient immobile. In the case of infant patients, these impairments often entail an abnormal physiological development. According to Vojta, the therapist tries to access elementary movement patterns (e.g. sitting, straightening, and standing upright) the patient does not have at his or her natural disposal. This is achieved by systematically applying pressure to defined body zones on the patient in order to activate the CNS (the so-called reflex locomotion). The patient, in turn, unconsciously reacts to this stimulation with genetically coded movement patterns, potentially leading to the formation of new neuronal connections and associated movement capabilities. Further, the treatment has adjuvant effects on the patient's body and behavior such as an altered blood pressure, blood circulation, and breathing (Bauer et al. 1992), implying novel ways of sensory measurement techniques yet to be explored.

Within the project, the project members have identified three major usage scenarios based on the experience of the therapists and physicians as well as the technological feasibility assessed by IT experts. The scenarios form the foundation for subsequent research and design activities: (1) Commonly, since patients cannot perform the treatment by themselves, caregivers (here: parents) perform the therapy on the patients (here: infants and children) within an ambulatory setting (e.g. at home) (compare to Dirks and Hadders-Algra 2011). The treatment needs to be applied multiple times a day over a longer (often life-spanning) period of time, which renders constant clinical visits unfeasible. To that end, the system will be designed for supporting these treatments by providing contextual feedback and information regarding the treatment execution, such as detecting treatment errors during the session (e.g. wrong body zone), providing appropriate handles based on the patient's reactions, or giving access to further learning material. The feedback will be based on heterogeneous data (e.g. sensory data, specifications of the therapist, or manual user queries). (2) In order to capture movements and other physiological data in a detailed manner, enabling its subsequent analysis and the provision of feedback, the utilization of hardware such as depth cameras and acceleration sensors (e.g. inertial measurement units) appears to be feasible and profitable. Further, these devices enable the measurement of quality and quantity of treatment sessions, empowering the therapists and physicians in charge to control the therapy progress. Hence, this scenario might entail possible positive effects on patient compliance and the ability to adjust the therapy in a more efficient and goal-oriented way. (3) The guidance of therapy sessions described in (1) is also suitable for being applied within educational settings in form of a training tool for apprentices.

Regarding these three scenarios, different stakeholder groups have been identified besides the developers themselves. The selection of these groups is based on initial research on the Vojta therapy principle and fields of application, the processes within the participating clinic, and the experience and routines of the involved medical experts. Each of the distinct groups holds relevance within respective use cases: (1) Parents and caregivers, (2) physicians and therapists, and (3) apprentices. To address the whole spectrum of predominant usage scenarios, the values within each population need to be empirically analyzed. Since usage scenario (1) and (3) largely resemble each other and apprentices represent a sub-group of stakeholders from the medical domain, we focus on physicians and therapists within our empirical investigations, yielding three stakeholder groups, i.e. developers, medical experts, and caregivers.

### 10.3.2 Research Design

To elaborate the set of relevant stakeholders, the values they pursue as well as potential value conflicts, and thus answer the proposed research questions, our research approach is threefold. (1) Within an initial exploration phase, we conducted four focus groups engaging stakeholders from domains being involved within the project, which are technical development and IT consulting, healthcare and physiotherapy as well as social and computer sciences (Mueller et al. 2018a, 2018b). We elaborated an initial set of ethical issues arising from the system design and its future application supporting therapeutic treatments at home or in the clinic. From the issues discussed, we derived values and initial design approaches that are potentially able to resolve occurring conflicts. (2) Within a subsequent empirical phase, we conducted interviews engaging parents who treat their children at home. That enables us to investigate the user context, individual values pursued by the parents when it comes to their children's condition and the therapy itself, and the interviewees' needs and concerns regarding the digital treatment support. The empirical investigation delivered user requirements regarding desired and undesired system features. (3) The last step starts with a triangulation of the gathered data. Values relating to each respective stakeholder group are brought together, enabling the identification of intersections, conflicts, and mutual complementation. Different understandings and assessments of values enrich the scope of each identified value. This phase concludes with the discussion of value conflicts and the potential resolution by design.

### 10.3.3 Data Collection and Analysis

With regard to the first phase, we conducted four focus group workshops, involving a sample of 19 participants. We utilized a convenient sampling approach, recruiting stakeholders from different disciplines from the research project in which the study takes place. The sample consisted of 17 male and 2 female participants, aged between 26 and 60 years (40 years on average). The professions ranged from software and hardware developer, IT consulting specialist, physiotherapist, and physician to social, computer, and data science researcher. Each of the participants holds a specific role within the project, elaborating the medical and scientific baseline as well as the technological design and evaluation. We conducted the focus groups in two steps, one initial session engaging all 19 participants, followed by three subsequent sessions (n=7; 6; and 6), each involving stakeholders belonging to one specific domain. For session planning and execution we followed the guidelines by Powell and Single (1996). The initial session took 120 minutes; the following sessions took 90 minutes each. Each session was executed cyclical, underlying a high moderator input following a semi-structured procedure, accompanied by a note-taker. Participants were asked to write down values and ethical issues within the project and discuss them afterwards in plenary. This procedure yielded rich discussions across different domains and interests (first session) as well as focused discussions and investigations from each distinct domain (sessions 2 to 4). The initial session, starting from a blank slate of values, yielded an initial value categorization. The three subsequent focus groups discussed these values in more detail in a round-based fashion, each adding a domain-specific perspective. The results from the initial session functioned as the baseline for discussion within the subsequent workshops, still allowing new values to emerge. Data analysis of the focus group results was done iteratively. To reduce empirical bias, we did not import preconfigured values. Instead, we opted to build our analysis and emerging categories upon a blank slate. First, both authors clustered the data gathered during the initial focus group session forming an initial set of values. Exemplary codes are “increasing dependence on the system” (Autonomy), “system error handling by the user” (Competence), “confidentiality of data” (Privacy), and “discrimination through objectification” (Diversity). Second, since the three focused workshops were based on the initial value categorization, each focus group session was analyzed individually, leading to new dimensions of the values identified. The final value categorization involved autonomy, competence, privacy, and diversity. The focus group procedures and analysis are described in detail in Mueller et al. (2018a, 2018b).

Regarding the second phase of our study, we conducted 13 interviews with parents, representing the user group of the system under development. The interviews took between 25 and 51 minutes (36 minutes on average). We utilized a convenient sampling approach, recruiting parents that were willing to participate via a clinic offering Vojta therapy. All interviewees were female (representing the majority of patients according to the physicians) and aged between 29 and 49 years (36 years on average). Most of the parents were stay-at-home mothers, primarily taking care of their children. The sample yielded interviewees with different levels of experience, ranging from several years of treatment to beginners. Following the methodological approach by Deng, Joshi and Galliers (2016), we conducted interviews consisting of open-ended (narrative) and semi-structured questions. Open-ended questions enable the generation of individual narratives and inherent values the interviewees pursue, asking about everyday life situations, their handling of the condition, their own well-being as well as salient feelings and needs related to the treatment at home. Semi-structured questions aim for exploring the treatment digitization, asking how an assistance system can aid the parents at home and which benefits or trade-offs might occur.

This part of the interviews involved pre-conceptions on possible technological approaches to support treatments in order to antagonize a possible lack of imagination, since the interviewees might not exhibit experiences regarding the functionalities and usage of digital assistance systems. In doing so, we call upon the concept of pre-users, which are termed as “individuals and groups who do not have well developed notions of how digital technologies fit into our affect their lives” (Deng et al. 2016) (p. 8). Since ambulatory assistive technologies are scarce and novel, they lack knowledge on how such a system can (or should) be designed. They have no “point of reference against which to judge ‘use’” (Le Dantec et al. 2009) (p.8). With regard to VSD, this interview procedure corresponds to an indirect approach (Friedman et al. 2013). It suggests asking interviewees about everyday life situations encompassing values that are important to them. In doing so, the priming of participants with pre-conceptualized values can be avoided, which enables them to explore the matter in an open-minded way. Thus, we seek to avoid privileging “a discursive definition of values over values that may be discovered or encountered through investigation” (Le Dantec et al. 2009) (p. 1). For instance, the value of autonomy may significantly differ from what prevalent norms impose, since restricting patients’ autonomy while using the system does not necessarily correlate with less effective and satisfying outcomes. Patients might value the physician’s input (promising health and recovery) over their own way of performing the treatment. We finished collecting data when novel insights stopped to emerge, implying a theoretical saturation of our data.

The interview data was analyzed ex post, which means we started coding the interviews after the last one was conducted. In doing so, we intentionally renounced collecting and analyzing data iteratively in order to let the individual values emerge without being influenced by preceding interview sessions, hence reducing the bias in our data. This represents a prerequisite to the narrative part of our interview guideline, since we (a) are unable to anticipate the highly context-bound and individual outcomes and (b) do not want to impose already derived values on other interviewees. To analyze our data, we adopted the coding procedure by Deng et al. (2016). Since our data sample is much smaller than the one they coded, each of the two authors coding our data analyzed every interview, hence adapting the procedure to our study. Our data analysis procedure involves three steps. (1) Each researcher coded every interview independently while using the four value categories gathered from the focus groups as an initial coding scheme. (2) Afterwards, the researchers discussed their codes and occurring disagreements, yielding new value categories as well as new facets of already identified values. Fourteen value categories emerged, whereas 72% of the codes matched across both rating authors. Merging five of the values into two yielded a common coding scheme consisting of 11 categories. (3) Each researcher re-coded the interview data according to the elaborated scheme, followed by another discussion and resolution of disagreements regarding the assignment of values to the interviewees' statements. We assigned between six and ten values to each of the 13 interviews (average 8.5, median 9 values per interview). This procedure led to a final value categorization involving eleven different value definitions, which are well-being, trust, privacy, certainty, assurance, competence, autonomy, continuity, humaneness, accuracy, and usability. Table [20] shows two examples depicting our coding process.

| **Statements** | **Values** | **Value Categories** |
|---|---|---|
| "*We apply the therapy with the same therapist from the beginning, since she knows my child and can assess the development. She knows the clinical prehistory, so you do not have to explain it all over again*." (Int. 4) | Increasing level of knowledge regarding the patient. | Continuity: Stable environment and strong binding between patient and therapist. |
| "*In that moment I was somewhat desperate, am I doing it right? The child was crying, I felt really uncertain. If the appointment was not any time soon, I would definitely call my therapist for help*." (Int. 12) | Feeling of desperation and need for help and feedback. | Assurance & Certainty: Feedback and confirmation on correct execution. |

**Table 20: Exemplary Interview Data Coding Process**

To identify inter-value conflicts across our findings based on focus group and interview data, we conducted a final data analysis step. When it comes to design, a conflict occurs if "one value will point in the direction of one particular design and another value in the direction of another" (Van de Poel 2015) (p. 90). Hence, we identify an inter-value conflict once two design choices contradict or hamper each other, or are not feasibly implementable at the same time. The analysis is based on the final value scheme comprising all twelve values the different stakeholders pursue as a whole as well as the empirical evidence behind them. First, we formed the cross product of all values, matching each of them against each other, leaving out duplicates. Second, we looked at each connection individually, checking it on potential conflicts based on the value definitions we previously derived from our interview and focus group data. Thus, conflict potentials were identified based on frictions between and within interviews as well as focus group transcripts. This procedure led to the identification of six value conflicts, forming the baseline for our forthcoming discussion with regard to the conflict solving potential of specific system design choices.

## 10.4 Findings

### 10.4.1 Focus Group Findings (The Developers' Perspective)

The analysis of the focus group data yielded four value categories (see Mueller et al. 2018a, 2018b).

**Autonomy** describes the degree to which the user is able to control the system behavior during a therapy session. The system should offer different forms of guidance according to the user's preferred level of autonomy during the treatment. Here, low levels of guidance allow individual approaches, such as personal treatment paths and handles that work best for the treating user in each situation. In opposition to that, higher levels of guidance impose a predefined treatment procedure, hampering the user's ability to adapt during the treatment sessions but also potentially lowering the risk of wrong therapy execution.

**Competence** relates to the preservation, increase, or generation of individual skills of the user. Further, the value implies the necessity to avoid a decline of achieved skills or the absence of learning effects. The latter, for instance, potentially can be caused by too much guidance by the system, tempting the user to exclusively follow instructions given by the system. Accordingly, different forms of feedback (e.g. audio or haptic feedback) during the treatment can lead to higher levels of user competence and confidence. For example, subliminal feedback (e.g. vibration of a body-worn device) can lower the level of distraction of the user, increasing the focus during the treatment and potentially boosting learning effects.

**Privacy** involves measures in order to safeguard the user's privacy and protect data from unauthorized access. On the one hand, this can be achieved by developing a closed system without an internet connection, storing data locally, disabling data transfer, and thus giving the user control over accruing data. In addition, there should be different layers of access authority, giving privileged users (e.g. physicians) access to certain data. On the other hand, privacy can be achieved by specific ways data captured by the system's sensors is visualized and stored. For instance, by utilizing a generic, humanoid model instead of real video footage, sensible data captured by sensors can be obfuscated in accordance with the user's individual privacy settings without lowering the informational content of the data.

**Diversity** describes the degree to which the system is designed for a heterogeneous population, for instance regarding the users' age, gender, and cultural background. This can be achieved, for instance, by collecting a set of different data and not relying on single source measurements (e.g. camera), thus the system becomes applicable by a wider population. As a result, the physiological constitution of the patient (e.g. disembodiment) does not lower the system's functionality and therapeutic effectiveness. Complementary, this value involves the accessibility of the system, for instance by implementing interfaces using smartphones many users already own (lower costs) and know how to operate (usability).

### 10.4.2 Interview Findings (The Parents' Perspective)

In total, eleven values emerged from the interview data, which are well-being, trust, privacy, certainty, assurance, competence, autonomy, continuity, humaneness, accuracy, and usability. For presentation purposes, we assigned each interviewee a random number in order to prevent the potential identification of participants, for instance through the order of interview conduction. We chose representative statements that support each value, which might lead to the repeated citation of the same interviewees. Further, every value was assigned with the numbers and percentages of interviews it emerged from.

**Well-being (Interviews 1 to 12; 92%)** is the fundamental value and refers to the health and physical comfort of the child to be treated as well as the parents who carry out the treatment at home. The child's health is the overall objective of the therapy. The child's safety has to be guaranteed. Besides this, every treatment requires physical effort of the child and the parent. This physical effort often leads the child to demonstrate refusal by screaming and crying, which in turn induces high psychological stress for child and parents. Moreover, many parents express a feeling of burden, since they have to integrate the therapy into their daily routine, which comes with many changes in everyday life. Yet, the firm belief that the therapy improves the child's health is the main motivation for doing the therapy.

> "*The challenge of course is to integrate all this into everyday life. That you perform the exercises at least three times a day, even so you got other appointments or are on the way. […] It often takes three to four weeks to get used to a new exercise and you have the routine again. […] Even the child has to get used to it*." (Interviewee 3)

With regard to technology design, well-being means that any technical solution is conceivable as long as an additional benefit can be expected. According to the interviewees, the technology can possibly reduce the number of appointments with the doctor. This especially helps families with long travel distances to the doctor. Yet, the new arrangement of the therapy coming along with new technology must not comprise the success of the therapy. Cables and sensors attached to the child's body are seen as critical by some of the interviewees since children tend to refuse such objects. Some parents express the fear of being monitored, controlled and pressured by the technology. On the one hand, this might have an additional motivational effect. On the other hand, it would increase the psychological burden of the parents.

**Trust (Interviews 1 to 6, 9 to 12; 76%)** is the belief that the therapy is effective for improving the child's health. Since it is hardly possible for many parents to notice immediate improvements, trust is directed towards the expertise of the doctors and therapists. Their medical advice, analyses, and instructions are essential for the trust into therapy itself. If the parents do not follow the instructions, the therapy will be unsuccessful.

> „*It is hard in the beginning, in case the kid is yelling and crying, it is simply very hard to endure. You can always see the child's exertion during the therapy, I find that very stressful for the parents. […] I have just believed in the therapy working out*." (Interviewee 9)

A technology can support trust into the therapy by analysing and displaying progress and, in doing so, demonstrating its effectiveness, which has been advocated by the majority of interviewees. For this, trust into the system itself has to be implemented first. Some parents doubt the reliability of such a technology and expressed a set of conditions. Further, the interviewees argue that the system has to be developed and thoroughly tested by experts and the therapists themselves; instructions, frequent checks, and decisions should be done by the therapists and not by the system; the system should merely be seen as an additional supplement to the therapy; it should have been recommended by the treating doctor; regular meetings with the doctor have to continue; and system recommendations should correspond to own experiences.

**Privacy (Interviews 1, 3, 5 to 7, 12; 46%)** refers to the protection of private and intimate information about the child, the parents and the therapy. Such information might include nude photos or videos of the child, private interaction between parent and child as well as medical information.

> "*I would probably feel monitored. Because you do and speak certain things with the child and I think it would simply feel too intimate, because it can be awkward in case you imitate animal voices or stuff like that. I think not everybody has to see this. It is too private. Of course you behave differently at home, but you try to do everything to make the child do the exercises it does not like. [...] I would find that too intimate*." (Interviewee 12)

A technology is a potential threat to privacy. Unauthorized access has to be prevented. Parents could feel additionally monitored during the treatment, which could lead to a feeling of pressure. A few parents express concerns about data security. They do not want the system to be connected to a network and suggest that the entire data is stored locally on a separate device. Only data relevant to the therapy should be stored and transmitted to the therapist. Sensor-based data are seen as less critical by the parents than visual data such as pictures or videos. A camera could render the parent feeling more insecure.

**Certainty (Interviews 1 to 13; 100%)** is the feeling of performing the treatment correctly and having confidence in one's own actions. Certainty represents the desire of following the therapist's instructions as precisely as possible. This value is of great importance since the parents are usually non-professional physiotherapists and the correct execution of the treatment can be highly complex. That is why every interviewee could describe situations in which they felt insecure about the correct actions, for instance, in case of new movements, when the child is crying, or when the child is not reacting as it should.

> „*A therapist cannot visit you at home all the time. But at home you sometimes struggle with how the exercise is performed correctly. [...] Especially in the beginning, when you do [the treatment] in the very beginning you are very uncertain*." (Interviewee 6)

An assistive technology could support certainty by giving advice on how to carry out the treatment correctly. According to the interviewees, especially at the early stage of therapy, when the parents are still inexperienced, or in situations of insecurity, additional help can increase certainty. Help can be given by providing exemplary pictures and videos for guidance or displaying real-time recommendations. A system could further support by providing immediate contact to a therapist in moments of insecurity.

**Assurance (Interviews 1 to 13; 100%)** refers to the desire of seeing progress in the child's health condition. For this, parents usually consult the doctor or therapist. Dependent on the disease, progress can be hardly observable. Reasons for that can be the therapeutic goal merely consisting of stabilizing and preserving the current health condition or therapeutic progress is very slow and only achievable in the long run. Furthermore, visible progress is referred to as a major motivational factor.

> "*There was this moment when I asked myself why I am doing these exercises, why don't I leave my child alone. Then I was told that if I did nothing the child would be more spastic. [...] This little progress, when you are told that you're doing good, you simply hope for more. I wish my child would make more progress [...] I see small things by myself, for instance when [the child] breathes more smoothly, but I need feedback on this sometimes. The therapist said the kid breathes calmly, which I did not see or register. When someone tells you that, you know why you are doing this again*." (Interviewee 10)

According to both experts and interviewees, technology can support assurance by collecting data of the therapy. The data can be used and analyzed to visualize progress. This can be done by transmitting the data collected at home to the therapist. The therapist can make use of the data to improve treatment analysis, which – according to the medical experts – currently is entirely based on direct contact with the parents and children. In doing so, feedback from the therapist can be given without the need of face-to-face contact. Additionally, the system itself could carry out analyses and give immediate feedback to the parents, which has been highly valued by the interviewees. For this, camera and sensors have to be able to capture many small details, since assurance is particularly important for progress, which non-professionals (i.e. the parents) can hardly observe. A further feature would be a long-term documentation of progress, which the therapists and physicians in particular deem useful.

**Competence (Interviews 1 to 13; 100%)** is needed to carry out the treatments correctly. The parents need to know the correct sequence of actions as well as understand and adapt to the reactions of the child. That is why every parent regularly receives lessons and instructions. Competence development is based on learning-by-doing and immediate feedback by the therapist in multiple sessions.

> "*I feel nowhere near competent enough, even so I have been doing this for years. You do not do this on a daily basis and do not have the education [the therapists] have. I always think it is not effective enough what I am doing. [...] When experts do the exercises, the results are different from when I am do it. [...] Maybe you can offer courses for parents in which you are controlled more precisely. Something like that, giving you more self-confidence*." (Interviewee 9)

Technology could provide parents with learning material, such as step-by-step guidance including visual material. As stressed by some of the interviewees, this is especially important for the early stage of a therapy. A technical assistance could additionally help to "see more sharply", since the reaction of the child can be highly complex and multiple parts of the child's body have to be observed at the same time. Some parents also wish for a general knowledge base, explaining the nature and goals of the therapy.

**Autonomy (Interviews 2 to 4, 6 to 13; 84%)** is the freedom to carry out the treatment as the parents consider it appropriate. Dependent on the individual child and the child's mood, the appropriate form, quantity, and time of treatments may vary. In the course of therapy, parents develop a feeling for how to refine the details of a treatment so that it works best for their own child.

> "*In case the therapy does not run that smoothly, I try to approach it in a playful way. Try to make it more positive for the child by using stuffed animals, positive coaxing [...] the exercises only work when the child cooperates. Sure, you can work against it by forcing the children to do so. But in this case you overstrain yourself and can't focus, interrupting the exercise. It makes no sense. Postpone it, cancel the exercise, try again in an hour*." (Interviewee 3)

For the technology, autonomy means that it has to react adaptively to changes in the treatment and overall therapy. It can provide guidance, yet it cannot substitute the individual assessment of the parents. Not every deviation from the ideal way should be treated as wrong, as pointed out by several interviewees.

**Continuity (Interviews 1, 4, 5, 7, 9 to 11, 13; 61%)** refers to the parents' desire to maintain a stable environment for the therapy and to develop a routine. Especially a close and fix binding to the therapist in charge is of great importance, since the therapist themselves is supposed to develop an own feeling for every child. This includes that the therapist should be accessible at any time.

> „*I always appreciate it when I am assigned the same good therapists for my child, so that there is no permanent change. Basically you develop a relationship, you simply know each other. I do not object exercising with others as well, that is also okay most certainly. I am also aware that everybody has another view on the whole matter. But such a continuity has proven itself in our case*." (Interviewee 9)

Due to the value of continuity, some parents want the technology to transmit data only to the individually assigned therapist. It should not interfere with the close relationship between the parents and the therapist. Hence, it could be used as a communication tool between them to support continuity.

**Humaneness (Interviews 1, 2, 4 to 13; 92%)** refers to the parents' desire to have human guidance during therapy. Almost all parents state that they would not wish to reduce human contacts even if they had an assistive technology. They prefer to cooperate with professional human beings thoroughly.

> "*I would continue making appointments at the clinic [despite using the system]. I think it is a different thing to do the whole therapy with a trained human therapist. I value the consultation in this case, that you can talk with each other. This chatting, how has it been [at home], I would not give up on that. I also find it important being told as a parent that you did great, that everything seems to work at home. I would not forego that entirely*." (Interviewee 6)

Even though the implementation of a technology appears to contradict the value of humanness, it could be used to support human contact. A video conferencing feature, similar to Skype, could establish contact with the therapist during treatments at home, which a majority of parents deem useful. Video and sensor data, thus, could be used to support the exchange between parents and therapist. Nevertheless, the reduction of face-to-face contact should not be the focus of a new technology-based arrangement of the therapy and should be very carefully dealt with.

**Accuracy (Interviews 5, 7, 11, 12; 30%)** of the data generated by camera and sensors is necessary for a meaningful assessment of the therapy. Accuracy is one of two technology-related values emerged from the data. Many parents expressed their concern that current technical solutions are not capable of capturing and analyzing data at the level of detail required for the therapy, because, for instance, the exact locations on the child's body, the correct pressure, or the slightest reaction of the child have to be precisely recognized. Yet, if the technology was capable of doing this, the benefit for the parents would be immense, since they often struggle with the amount of details they have to assess during treatments.

> "*It is difficult, the therapists work a lot by their tactile senses and with their hands. I can hardly imagine that sensors can equally register this. A lot of it [the treatment] works via the skin, you feel the kid moving beneath your fingers, there are sometimes very subtle movements. […] The execution itself, whether the child lifts its leg or hands, can be registered, of course. But these subtleties, the really decisive things, I can hardly imagine that.*" (Interviewee 7)

**Usability (Interviews 1 to 3, 5, 6, 8, 10, 12; 61%)** is the degree to which the system is intuitive and comfortable to use during the treatment. It is the second technology-related value. Most importantly, the system must not overwhelm the parent during a treatment, since they have to focus on many details already. Here, very basic audio-visual means such as colors or subliminal sounds should be implemented according to the interviewees. The system should be easy to install around the place in which the treatment is usually carried out. Body sensors should be very easy to attach. Between treatments, clear and simple guidelines based on videos and pictures could be offered.

> "*I think a sound would be best. You are focusing on the child and the exercise, you could not hold your view on a display the whole time, a sound would be the more pleasant signal […]. You would have to move your view away from the child […] and you simply do not have this opportunity. […] If there would be too much resonance, in case you start the exercise, aren't ready yet and there would already be a form of correction […] that would annoy me. The control should start when I'm certain that I've my hands where they should be.*" (Interviewee 3)

### 10.4.3 Potential Value Conflicts

In total, six conflict potentials emerged from the values identified and their crosswise analysis.

**Well-Being vs. Privacy and Autonomy:** The value of well-being covers the actual 0bjective of the therapy that is to improve the child's health. The main purpose of using technology in therapy is to support this objective. As soon as the use of technology is effective in doing so, technology-restricting solutions might be in conflict with well-being. Privacy, for instance, might require solutions to limit or considerably complicate data exchange with the therapist. As a result, the therapist’s assessment might be less precise than it would be with unlimited data exchange. Another example is the value of autonomy, which requires the technology to deal with deviations from the ideal way of executing the treatment. Although a certain degree of autonomy is needed for the well-being of child and parents, too much autonomy might endanger the effectiveness of the therapy.

**Trust vs. Assurance:** So far, trust in therapy is mainly dependent on trust in the therapist and on your own impression of the therapy. By including a technology, which is capable of analyzing progress (cf. assurance), an additional source for trust-building is provided. Trust in therapy is then further dependent on trust in the technical equipment used in the therapy. Trust is weakened as soon as one of the three sources of trust (therapist, self, technology) contradict each other. For instance, trust is at stake when the therapist claims the therapy to be a success but your own impression and the feedback from the technology state the opposite. As a reaction, either trust in the therapist might be reduced or trust in yourself and the technology is lost. Whereas assurance of progress is necessary for trust-building in therapy, the inclusion of additional trust-building sources such as a technological feature increases the risk of inconsistencies between the sources, which in turn might reduce overall trust.

**Competence vs. Certainty and Assurance:** Parents need a sufficient degree of competence to effectively carry out the treatment at home. This includes the competence to follow the therapist’s instructions as precisely as possible and to understand the child’s reactions. The use of technology as a supporting tool means that it will take over certain tasks, which so far have been executed by the parents. Consequently, parents might (over)rely on the technology and lose their competence in executing the tasks in the long-term, which have been taken over by the technology. The value of certainty, for instance, requires the technology to give advice on how to carry out the treatment correctly. Assurance demands the technology to give feedback on the child’s reactions. Both values effectively manifested in a technical system might lead to cutbacks to the parents’ competences if they are not required regularly.

**Humanness vs. Accuracy:** Parents desire frequent face-to-face contact with the therapist. This desire expressed by the value of humanness means that parents would hardly accept technology to replace human contact. Humanness restricts a too extensive use of technology. Yet, as soon as technology is capable of replacing a human because it provides a more accurate assessment of the therapy (cf. accuracy), then the question arises whether the frequency of face-to-face sessions has to be maintained. The more accurate the technology becomes, the less necessary are visits on a regular basis. This threat has led many parents to express their fear of a decrease in the number of human contact with the therapist.

**Certainty vs. Autonomy:** The value of certainty requires the therapist or the technology to provide the parents with precise step-by-step instructions. Autonomy, on the other hand, is demanded by the parents to adapt treatments to the individual reactions of the child or other circumstances. These two values might be in conflict with each other on a conceptual and technological level. On a conceptual level, step-by-step instructions restrict autonomous changes in the execution of treatments. On a technological level, real-time instructions based on the immediate analysis of the data captured by camera and sensors might restrict individual deviations even further. The capability of the technology to understand the state of the ongoing treatment requires the executing parent to carry out the treatment within the bounds of what a technology is capable of understanding. Conversely, a technology without or with very limited real-time assessment of the treatment might not as sufficiently support the value of certainty as it actually could.

**Privacy vs. Assurance:** Privacy requires the technology to capture only therapy-relevant data and to limit or control data exchange with the therapist. Assurance, on the other hand, demands for regular data exchange with the therapist to evaluate the progress made during therapy. So far, without technical equipment capable of collecting data, privacy has been guaranteed by limiting data exchange to direct contact during face-to-face sessions. By including a technology, the amount of data collection and transmissions might increase immensely and, thus, put privacy at risk. On the downside, the limitation of data exchange might undermine the quality of assurance, which is of great importance for the parents' motivation and progress in therapy.

## 10.5 Discussion

With regard to our two initial research questions, our findings unveil prevalent values pursued by the stakeholders involved (RQ1) and several emerging conflicts (RQ2). Since VSD seeks to find concrete technological designs that are able to mitigate ethical conflicts in system development and use, we discuss these value discrepancies in the light of potential design routes within our specific context. We link knowledge from literature to the inter-value conflicts and their potential resolution by design.

The *Well-Being vs. Privacy and Autonomy* conflict involves the potential decline in therapeutic effectiveness caused by limitations designed within the system due to privacy and autonomy preferences. As research has shown, therapy monitoring and long-distance transfer of health-related data can yield significant benefits for health and therapy effectiveness (Ricci et al. 2008). Since the well-being of patients and caregivers should assumably always be prioritized, designers can opt to create some form of awareness regarding the benefits the system provides. This can be done by empowering the user to freely choose and adjust the degree the system preserves privacy and autonomy during treatments. For instance, when it comes to situations where more extensive data exchange with the clinic would be beneficial, the system might suggest to lower privacy settings (while preserving data security standards) for the sake of an optimized treatment outcome. Within the given technology design, in accordance with our focus group findings, anonymized and humanoid body models can replace real video footage without lowering the informational content of submitted data to the clinic, thus representing a possible technical solution.

With regard to the *Trust vs. Assurance* conflict, since developers are not able to reduce any potential of the user's trust decline, the goal of the system design at hand should be to implement more 'trustworthy' features and user interactions, fostering a feel of safety and confidence. For instance, this can be achieved by looking at the interplay of familiarity and trust. The patients' "familiarity enables judgements to be made about the circumstances in which something (a decision, an artefact or some piece of information) might be more or less reliable" (Jirotka et al. 2005) (p. 16). Familiarity, in our case, refers to the degree to which the system behavior (e.g. feedback on progress) corresponds to what they are used to from the clinic. Since familiarity can be seen as a predicate for trust (Jirotka et al. 2005), patients might credit information provided by the system that has been approved by the therapist in charge. A technical solution would be to provide 'familiar' feedback based on former treatments and procedures. In addition, the provision of feedback assessed by a therapist in advance is able to increase trust in the system.

The conflict involving *Competence vs. Certainty and Assurance* addresses a potential decline in user competence caused by an overreliance on the system's support and feedback. Parents using the system during home treatments might be prone to strictly follow instructions the system provides, especially in situations where they feel uncertain or overstrained, potentially impeding the generation of skills and therapy-related knowledge. In order to antagonize this, the instructional strategy of 'adaptive guidance' can be adopted within system design in addition to using subliminal forms of feedback. The strategy suggests to provide users with descriptive feedback on past performances (here, for instance, accuracy of prior treatments) and complement it with future-oriented information on what they should focus on in order to achieve 'mastery' in what they are doing and learning (Bell and Kozlowski 2002). In doing so, the users are empowered to deliberately allocate their focus on specific components during the therapy. On a design level, the system thus needs to monitor and store treatment sessions and outcomes, identify areas of improvement, and provide future-oriented feedback instead of pure real-time focused guidance.

The *Humaneness vs. Accuracy* conflict is based on the presumption that highly accurate measurement, data analysis algorithms, and resulting user guidance might render clinical visits and physician consultation, thus reducing or even extinguish human contact. However, the encouragement and feedback by therapists and physicians are highly valued by patients, implying a prioritization of humaneness in this regard. While the complete replacement of physical human contact with therapists is throughout refused amongst the engaged parents and medical experts, system design might incorporate 'human-like' features while still providing highly accurate, effectiveness and efficiency enhancing measurement and feedback. The system investigated in this paper represents a more human-like technology, since it supplements and partly replaces actions performed by therapists and physicians. Hence, users might develop more trust in and acceptance towards the technology when it is perceived as more 'human' (Lankton et al. 2015). One way to render technologies more human is to increase their social presence, which describes the degree to which another person and mutual interactions within a mediated communication is perceived. Technologically this can be achieved, for instance, by implementing personalized, authentic texts and voice messages provided by the system or the visualization of human images, in this case representing the therapist in charge (Lankton et al. 2015).

The conflict involving *Certainty vs. Autonomy* obliges the system to increase certainty and confidence while preserving autonomy and the option to adapt within certain situations. One way to approach this conflict is to create user-sided awareness on the suitability and contingent necessity of naturally occurring adaptations during treatment sessions, for instance in case of non-compliance by the child. This might lessen the 'dogmatism' and unobstructed validity associated with the instructions and feedback given by authorities (i.e. therapists and the system). The awareness can be achieved by empowering the user to choose from applicable treatment paths that are based on previous treatments and experience. To some degree, the user is able to take responsibility of the course of the treatment session, which, in turn, leads to greater autonomy and associated self-confidence (compare to Maclellan 2014). Hence, higher levels of user confidence can be formed at home, fostering a feeling of certainty during the therapeutic execution.

As a concluding conflict, *Privacy vs. Assurance* deals with the dilemma of establishing real-time feedback and assurance given by medical experts while maintaining privacy. On the one hand, the lack of assurance, especially during treatment sessions at home, might invoke a user-sided feeling of uncertainty. On the other hand, the partial replacement of formerly analogous communication between patients and therapists with digital methods threatens perceived privacy and intimacy of the treatment, which might lead to distrust and system rejection. As our findings suggest, the prioritization of assurance over privacy represents a feasible approach, since the well-being of the child as a result of proper treatment execution is of major value. Hence, in accordance with the focus group discussions, privacy enhancing technologies combined with modern security standards (e.g. encryption) should be deployed. The utilization of access control mechanisms protecting health-related information from unauthorized access has proven well within eHealth (Hung 2005). An increase of transparency about the data being captured, analyzed, and transmitted can result in more perceived privacy warranty and accountability (Cavoukian 2009).

### 10.6 Implications and Future Work

This paper proposes a case study on the development of a sensor-based system, which is designed to support Vojta treatments performed by laypersons at home. We unveil relevant stakeholders, pursued values, and conflict potentials across the identified values that are at stake, following the VSD approach as a methodological lens. Due to the novelty of our study context and the lack of research on this important topic, this paper exhibits several implications for theory and practice. On a theoretical level, the implications drawn from our insights are two-fold. First, our methodological approach sheds new light on the execution of VSD investigations. The re-arrangement of steps by starting with empirical investigations seems feasible, since they induce unbiased and diverse values. In doing so, we contribute to research that questions the universalism of pre-configured, imported values and promotes explorative approaches (Dadgar and Joshi 2018; Le Dantec et al. 2009). Second, our findings show novel value conflicts arising from the digitization of Vojta treatments performed at home, each of them forming new links to adjacent research domains and theories. On a practical level, our study exhibits implications for future design of physiotherapeutic support systems. Arising value conflicts motivate new ways of thinking about healthcare systems design and enable the implementation of values within concrete system features, thus empowering developers to fulfill patients' needs and increase the acceptability of healthcare products.

Due to the empirical nature of our study, several limitations underlying the research design can be identified, motivating further research. First, cultural differences within and across stakeholder groups have been neglected. However, these differences might induce new values and dissonances, capable of supplementing our findings. Second, our approach solely deploys qualitative methods engaging rather small sample sizes, reducing the external validity of data. In addition, our data is context-dependent and strongly linked to the specific form of therapy. Quantitative studies (e.g. surveys) are able to address a wider population and gain significant and generalizable insights on values, conflicts, and designs.

Our study facilitates many opportunities for future research. First, the varying incidence of different values across our data implies different levels of importance. Whereas some of the values discussed above are shared by a majority of interviewees (e.g. Assurance), some are not (e.g. Accuracy), calling for larger-scale studies that shed light on the origins and reasoning behind different values. Additionally, studies can incorporate a wider array of health issues, potentially leading to new insights of higher external validity regarding value dominance in relation to varying factors (such as type of disease). Second, the translation of values and conflicts into concrete technological features calls for dedicated studies, for instance through (co-)design workshops and prototyping, engaging experts and patients as well. Here, the value translation procedure and conflict resolution strategies by Van de Poel appear to be helpful (Van de Poel 2013, 2015). Accordingly, our study opens up many ways of testing and evaluating ambulatory systems for digitized therapy support, which are value-sensitive and address real-world circumstances, needs, and interests. Distinct studies can investigate one or more of the value conflicts discussed in this paper, further enriching the body of knowledge of VSD as well as digitized treatments at home, all for the sake of health.

## Acknowledgements

This research article was supported by the SenseVojta project granted by the German Federal Ministry of Education and Research (BMBF) (No. 13GW0166E).

## 10.7 References

Aggarwal, D., Zhang, W., Hoang, T., Ploderer, B., Vetere, F., and Bradford, M. 2017. "SoPhy: A Wearable Technology for Lower Limb Assessment in Video Consultations of Physiotherapy," in Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems, Denver, Colorado: ACM Press, pp. 3916–3928.

Ballegaard, S. A., Hansen, T. R., and Kyng, M. 2008. "Healthcare in Everyday Life: Designing Healthcare Services for Daily Life," in Proceeding of the 26th Annual CHI Conference on Human Factors in Computing Systems - CHI '08, Florence, Italy: ACM Press, p. 1807.

Barry, M., Doherty, K., Marcano Belisario, J., Car, J., Morrison, C., and Doherty, G. 2017. MHealth for Maternal Mental Health: Everyday Wisdom in Ethical Design, ACM Press, pp. 2708–2756.

Bauer, H., Appaji, G., and Mundt, D. 1992. "Vojta Neurophysiologic Therapy," Indian Journal of Pediatrics (59:1), pp. 37–51.

Bell, B. S., and Kozlowski, S. W. J. 2002. "Adaptive Guidance: Enhancing Self-Regulation, Knowledge, and Performance in Technology-Based Training," Personnel Psychology (55:2), pp. 267–306.

Berry, A. B. L., Lim, C., Hartzler, A. L., Hirsch, T., Wagner, E. H., Ludman, E., and Ralston, J. D. 2017. "How Values Shape Collaboration Between Patients with Multiple Chronic Conditions and Spousal Caregivers," in Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems, Denver, Colorado: ACM Press, pp. 5257–5270.

Cavoukian, A. 2009. "Privacy by Design: The 7 Foundational Principles. Implementation and Mapping of Fair Information Practices". Information and Privacy Commissioner of Ontario, Canada.

Chandra, H., Oakley, I., and Silva, H. 2012. "Designing to Support Prescribed Home Exercises: Understanding the Needs of Physiotherapy Patients," in Proceedings of the 7th Nordic Conference on Human-Computer Interaction: Making Sense Through Design, Copenhagen: ACM, pp. 607–616.

Dadgar, M., and Joshi, K. D. 2015. "Diabetes Self-Management Using Mobile Apps: An Empirical Investigation Based On App Reviews And Through Value Sensitive Design Perspective," in 14th International Conference on Mobile Business (ICMB) (Vol. 16), Fort Worth, USA, p. 13.

Dadgar, M., and Joshi, K. D. 2018. "The Role of Information and Communication Technology in Self-Management of Chronic Diseases: An Empirical Investigation through Value

Sensitive Design," Journal of the Association for Information Systems (19:2), pp. 86–112.

Deng, X., Joshi, K. D., and Galliers, R. D. 2016. "The Duality of Empowerment and Marginalization in Microtask Crowdsourcing: Giving Voice to the Less Powerful through Value Sensitive Design," MIS Quarterly (40:2), pp. 279–302.

Denning, T., Borning, A., Friedman, B., Gill, B. T., Kohno, T., and Maisel, W. H. 2010. "Patients, Pacemakers, and Implantable Defibrillators: Human Values and Security for Wireless Implantable Medical Devices," in Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, Atlanta, Georgia, pp. 917–926.

Denning, T., Kramer, D. B., Friedman, B., Reynolds, M. R., Gill, B., and Kohno, T. 2014. "CPS: Beyond Usability: Applying Value Sensitive Design Based Methods to Investigate Domain Characteristics for Security for Implantable Cardiac Devices," in Proceedings of the 30th Annual Computer Security Applications Conference, New Orleans, Louisiana: ACM Press, pp. 426–435.

Detweiler, C., and Hindriks, K. 2012. "Value-Sensitive Design Patterns for Pervasive Health Care," in 2012 IEEE International Conference on Pervasive Computing and Communications Workshops, Lugano, Switzerland, pp. 908–913.

Dirks, T., and Hadders-Algra, M. 2011. "The Role of the Family in Intervention of Infants at High Risk of Cerebral Palsy: A Systematic Analysis," Developmental Medicine & Child Neurology (53), pp. 62–67.

Friedman, B. 1996. "Value-Sensitive Design," Interactions (3:6), pp. 16–23.

Friedman, B., and Kahn Jr, P. H. 2003. "Human Values, Ethics, and Design," in The Human-Computer Interaction Handbook, CRC Press, pp. 1177–1201.

Friedman, B., Kahn Jr, P. H., Borning, A., and Huldtgren, A. 2013. "Value Sensitive Design and Information Systems," in Early Engagement and New Technologies: Opening up the Laboratory, Dordrecht: Springer, pp. 55–95.

Friedman, B., Kahn, P., and Borning, A. 2002. "Value Sensitive Design: Theory and Methods," University of Washington Technical Report, pp. 2–12.

Harrison, G. W., List, J. A., and Towe, C. 2007. "Naturally Occurring Preferences and Exogenous Laboratory Experiments: A Case Study of Risk Aversion," Econometrica (75:2), pp. 433–458.

Huang, K., Sparto, P. J., Kiesler, S., Smailagic, A., Mankoff, J., and Siewiorek, D. 2014. "A Technology Probe of Wearable In-Home Computer-Assisted Physical Therapy," in

Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, Toronto, Ontario: ACM Press, pp. 2541–2550.

Hung, P. C. K. 2005. “Towards a Privacy Access Control Model for E-Healthcare Services,” in Proceedings of the 3rd Annual Conference on Privacy, Security and Trust, St. Andrews, New Brunswick.

Jirotka, M., Procter, R., Hartswood, M., Slack, R., Simpson, A., Coopmans, C., Hinds, C., and Voss, A. 2005. “Collaboration and Trust in Healthcare Innovation: The EDiaMoND Case Study,” Computer Supported Cooperative Work (CSCW) (14:4), pp. 369–398.

Kelly, M. P., Heath, I., Howick, J., and Greenhalgh, T. 2015. “The Importance of Values in Evidence-Based Medicine,” BMC Medical Ethics (16:1).

Knobel, C., and Bowker, G. C. 2011. “Values in Design,” Communications of the ACM (54:7), pp. 26–28.

Lankton, N. K., McKnight, D. H., and Tripp, J. 2015. “Technology, Humanness, and Trust: Rethinking Trust in Technology,” Journal of the Association for Information Systems (16:10), pp. 880–918.

Le Dantec, C. A., Poole, E. S., and Wyche, S. P. 2009. “Values as Lived Experience: Evolving Value Sensitive Design in Support of Value Discovery,” in Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, Boston, MA: ACM, pp. 1141–1150.

Maclellan, E. 2014. “How Might Teachers Enable Learner Self-Confidence? A Review Study,” Educational Review (66:1), pp. 59–74.

Miller, J. K., Friedman, B., Jancke, G., and Gill, B. 2007. “Value Tensions in Design: The Value Sensitive Design, Development, and Appropriation of a Corporation’s Groupware System,” in Proceedings of the 2007 International Conference on Supporting Group Work, Sanibel Island: ACM, pp. 281–290.

Mueller, M., Heger, O., and Niehaves, B. 2018a. Investigating Ethical Design Requirements for Digitalized Healthcare Support: The Case of Ambulatory Physiotherapeutic Assistance Systems. In Proceedings of the 51st Hawaii International Conference on System Sciences, Hawaii, USA.

Mueller, M., Heger, O., and Niehaves, B. 2018b. Exploring Ethical Design Dimensions of a Physiotherapeutic MHealth Solution through Value Sensitive Design. In Proceedings of the 24th Americas Conference on Information Systems, New Orleans, Louisiana.

Noble, P. J. 2015. “Resilience Ex Machina: Learning a Complex Medical Device for Haemodialysis Self-Treatment,” in Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems, Seoul: ACM Press, pp. 4147–4150.

Powell, R. A., and Single, H. M. 1996. “Focus Groups,” International Journal for Quality in Health Care (8:5), pp. 499–504.

Rennick-Egglestone, S., Knowles, S., Toms, G., Bee, P., Lovell, K., and Bower, P. 2016. “Health Technologies ‘In the Wild’: Experiences of Engagement with Computerised CBT,” in Proceedings of the CHI Conference on Human Factors in Computing Systems, San Jose: ACM Press, pp. 2124–2135.

Ricci, R. P., Morichelli, L., and Santini, M. 2008. “Remote Control of Implanted Devices through Home MonitoringTM Technology Improves Detection and Clinical Management of Atrial Fibrillation,” Europace (11:1), pp. 54–61.

Shilton, K., Koepfler, J. A., and Fleischmann, K. R. 2013. “Charting Sociotechnical Dimensions of Values for Design Research,” The Information Society (29:5), pp. 259–271.

Simons, L. P. A., and Verhagen, W. P. 2008. “Applying Value-Sensitive Design and Quality Function Deployment to Healthcare ICT: The Case of Dutch Primary Care Unit Dossiers,” J. of Design Research (7:2), pp. 155–176.

Spiekermann, S. 2015. Ethical IT Innovation: A Value-Based System Design Approach, FL: CRC Press.

Tang, R., Yang, X.-D., Bateman, S., Jorge, J., and Tang, A. 2015. “Physio@Home: Exploring Visual Guidance and Feedback Techniques for Physiotherapy Exercises,” in Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems, Seoul: ACM Press, pp. 4123–4132.

Van de Poel, I. 2013. “Translating Values into Design Requirements,” in Philosophy and Engineering: Reflections on Practice, Principles and Process (Vol. 15), D. P. Michelfelder, N. McCarthy, and D. E. Goldberg (eds.), Dordrecht: Springer Netherlands, pp. 253–266.

Van de Poel, I. 2015. “Conflicting Values in Design for Values,” Handbook of Ethics, Values, and Technological Design: Sources, Theory, Values and Application Domains, pp. 89–116.

Van den Hoven, J. 2013. “Value Sensitive Design and Responsible Innovation,” Responsible Innovation: Managing the Responsible Emergence of Science and Innovation in Society, pp. 75–83.

Von Schomberg, R. 2011. Towards Responsible Research and Innovation in the Information and Communication Technologies and Security Technologies Fields.

Vranceanu, A.-M., Cooper, C., and Ring, D. 2009. "Integrating Patient Values into Evidence-Based Practice: Effective Communication for Shared Decision-Making," Hand Clinics (25:1), pp. 83–96.

Walton, R., and DeRenzi, B. 2009. "Value-Sensitive Design and Health Care in Africa," IEEE Transactions on Professional Communication (52:4), pp. 346–358.

van Wynsberghe, A. 2013. "Designing Robots for Care: Care Centered Value-Sensitive Design," Science and Engineering Ethics (19:2), pp. 407–433.

# 11 Towards a Framework for Design Theory Building

| | |
|---|---|
| Title | **Beyond Intuition: Towards a Framework for Empirical-Based Design Theory Building in Design Science Research** |
| Number | **P5** |
| Authors | Marius Müller[1]<br>Oliver Heger[1]<br>Bastian Kordyaka[1]<br>Henrik Kampling[1]<br>Björn Niehaves[1]<br><br>[1]University of Siegen<br>Kohlbettstraße 15<br>57072 Siegen |
| Publication Type | Conference Proceedings |
| Publication Outlet | Hawaii International Conference on System Sciences |
| Status | published |
| Full Citation | Mueller, M., Heger, O., Kordyaka, B., Kampling, H., Niehaves, B. (2019), "Beyond Intuition: Towards a Framework for Empirical-Based Design Theory Building in Design Science Research", 52nd Hawaii International Conference on System Sciences (HICSS 52), Hawaii, USA. |

**Table 21: Publication Overview (P5)**

# Beyond Intuition: Towards a Framework for Empirical-Based Design Theory Building in Design Science Research

*Abstract*: Over the past twenty years, Design Science Research (DSR) has received major attention within the IS domain. Besides constructing and evaluating artefacts, researchers put effort into theorizing on IT design and its effects on users. Here, the development and testing of design theories is of major interest. Yet, design theory studies often lack empirical investigations on the identification of appropriate design features. Whereas in general DSR activities incorporate empirical investigations on many levels, the intertwined development of a theoretical model in connection with design features can further profit from empirical investigations by exploring the design realm of a specific context. We therefore propose a qualitative five-step approach suitable for inducing design features and theoretical constructs by engaging experienced stakeholders. We present a case study on the development of a support system for physiotherapeutic treatments, illustrating the proposed approach.

## 11.1 Introduction

Throughout the last two decades, Design Science Research (DSR) has experienced a major ascent, drawing more and more attention of Information Systems (IS) researchers to the scientific exploration, testing, and validation of IT artefact design. Looking at the history of DSR and the accompanying research agendas, practical and theoretical DSR activities have been treated rather dichotomously. Nevertheless, researchers increasingly conclude that theory and practice are thoroughly interwoven and can inform each other [25]. Thus, the construction, implementation, and evaluation of new IT artefacts were complemented by studies establishing theoretical foundations for proper technology design. As a result, the term “design theory” (DT) was popularized, though the researchers’ conceptions of a DT have been diverse (e.g. [2, 12]). DTs are highly valuable for DSR since they explain how and why specific design features have desired or undesired effects.

The understanding of what constitutes a design theory underwent an evolutionary development. Most recently, the concept of an explanatory Information System Design Theory (ISDT) has been proposed. In the vein of artefact construction, evaluation, and theorizing, an ISDT seeks to integrate technical and theoretical considerations, including a normative reasoning of effects hypothesized causes may have [25]. Through systematic manipulation of design features, which operationalize one or more independent variables (i.e. causes of effects), a proposed design theory can be tested within experimental and controlled set-ups [40].

Not only the understanding, but also the approach for developing a design theory is still evolving. When it comes to building a design theory model, which includes the development of design features for specific purposes, researchers, in most cases, make use of external theoretical insights in connection with their intuition for design (e.g. [38]). Hence, a lack of empirical foundation of the design process becomes evident. Besides intuition and/or de-contextualized factors as source of inspiration, appropriate technology design is rooted in context-bound, empirical evidence, for instance, generated by problem solving [13]. Due to the specific contexts new IT artefacts operate in, the transfer of external design knowledge in combination with the researcher's intuition might fall short in addressing the demands, technical and social requirements, and user concerns associated with the prevailing context. Although empirical investigations are applied for design theories by the experimental testing of a proposed theory, the operationalization of manipulable, independent variables in the shape of varying design features are often insufficiently founded in empirical investigations. Due to the situative nature of an IT artefact within an application area, researchers have difficulties to anticipate the cause-effect relations between specific design features and theoretical constructs. To be clear, we do not claim that DSR lacks inductive approaches in general. We specifically refer to the development of appropriate design features within design theory development.

To this end, empirical-based reasoning and inquiry can help to develop design theories with regard to different quality criteria such as feasibility, usefulness, and desirability of the technology design. When it comes to conducting empirical investigations boasting indefinite goals, courses, and results, explorative, qualitative research methods have proven to address these issues adequately (see for instance [39]). In this regard, focus group research (FGR) resembles an economically advantageous approach able to produce rich and explorative data [26, 33] and, thus, exhibits a high degree of suitability to inform the development of ISDTs. In this paper, we propose an empirical method aiming at the formation of context-bound, highly relevant design principles and associated theoretical constructs, enabling the empirically grounded development of design theories. Due to the duality of artefact and theory testing in our method, the specific design of an artefact is validated by validating the design theory, while the design theory is validated by validating the artefact.

## 11.2 Theoretical Background

### 11.2.1 Design Science and Theory Building

Design Science Research (DSR) resembles a major research field within the Information Systems (IS) discipline and has been driving research agendas for more than 20 years [25]. In this regard, many theoretical and practical basics have been developed throughout the years such as guidelines for the proper execution and evaluation of DSR activities [14], methodological frameworks dividing the underlying research processes into distinct steps (i.e. problem identification, goals, design, and evaluation) and illustrating them within use cases [28].

Theory building represents a major component of modern DSR. The discipline, besides creating and evaluating IT artefacts, strives to gain theoretical insights and build theoretical foundations. However, design theorizing within IS research has been critically discussed. According to March and Smith, for instance, theory building is rooted in behavioral science, hence it is not suitable to inform design-oriented disciplines with a technological focus such as IS [21]. In contrast, IT artefacts are implemented and used within social contexts, where human behavior is of major interest with regard to technology design. Hence, analyzing technologies under development through a theoretical lens is able to deliver valuable insights on IT construction and its impacts [25].

The term “design theory” (DT) has been extensively dealt with in scientific literature. Baskerville and Pries-Heje, for instance, define different characteristics a DT should exhibit such as its prescriptive nature and its practical application to inform future design choices and actions [2]. Further, a DT can be seen as a dual concept, covering a product and a process dimension. The product dimension refers to the DT’s form and function, whereas the process dimension addresses the scientifically substantiated development process of an IT artefact [12, 37]. This duality leads to the definition of two kinds of DT, which have been treated dichotomously in the past. (1) Design practice theories (DPT) specify how to construct an artefact, referring to the process dimension. (2) Explanatory design theories (EDT), on the contrary, specify why to integrate a specific feature within an IT artefact [2]. With regard to

EDT, the “exterior mode” of a DT seeks to answer the question on why an artefact with a specific design feature delivers better results than another artefact, which do not have this feature [11]. Similarly, a design-relevant explanatory/predictive theory (DREPT) seeks to investigate effects an artefact causes [19].

All of the above imply a conceptual separation of artefact construction and theory, thus, “evaluation results cannot be traced back to particular features” [25] (p. 2). This detachment of theory from IT development can be counteracted by applying so-called “kernel theories”, which form a knowledge base for DT construction and allow to draw on adjacent disciplines such as social sciences and psychology. This lead to the definition of an explanatory IS design theory (ISDT), consisting of “two or more connected hypotheses” (ibd. p. 4), each hypothesis describing a cause-effect-relation between independent (IV) and dependent variables (DV). Hereby, at least one IV needs to be systematically manipulable through design, additionally “at least one dependent variable is regarded as desirable or undesirable” (ibd. p. 4).

According to this conceptual understanding and definition of a design theory, theorizing within the DSR domain requires specific and technically implementable design features to which effects and theoretical insights can be traced back. The choice of design variations operationalizing the independent variable(s) of the kernel theory is by far no trivial task and is often rooted in intuition, expertise, or, in other words, abductive approaches towards occurring effects. For some researchers, abduction can offer valuable contributions for eliciting intelligent solutions [6]. Abduction in design science is described as having a putative role in scientific inquiry and knowledge creation [3].

However, this being said, ISDT construction particularly lacks the empirical foundation of design items, which in many cases are embedded within specific, technological research and development contexts and, thus, exhibit a situative character. This calls for a closely intertwined perspective on theory and artefact design and especially novel ways of design item development.

### 11.2.2 Quality Criteria of Design Choices

Throughout literature, several indicators can be found that address the quality of an IT artefact and the design features it incorporates. In the context of DSR and design theory building, examinations with regard to three major quality criteria appear reasonable: (1) feasibility of the IT artefact design (i.e. usefulness and added value), (2) ethical considerations (i.e. desirability and acceptability), and (3) its suitability for scientific investigations within a given context (i.e. it evokes significant effects that can be measured).

Feasibility studies represent a widely used tool to assess whether an IT artefact's development is reasonable from different perspectives (e.g. [29]). Low degrees of feasibility are fostered by the absence of usefulness, alleviating the acceptance of the artefact once it is brought to use [36]. In their study on evaluating the feasibility of information systems within healthcare und telemedicine, Judi et al. identify four aspects that contribute to technological feasibility, i.e. operational, time, economic, and technical aspects [15]. Operational aspects relate to the way the IT artefact fulfils operational needs and can be implemented in pre-existing structures and workflows. The time factor addresses the amount of resources the artefact requires to be properly used. From an economic perspective, (initial and ongoing) financial investments relate to long-term benefits, which are able to antagonize inhibitions regarding the purchase of the IT artefact. The technical aspect covers investigations on whether the artefact fulfils requirements the given infrastructure imposes, enabling a proper implementation. When it comes to building an ISDT, thus, the feasibility of the design items needs to be assessed beforehand.

Ethical considerations with regard to technology design choices and the impacts the information system will have (e.g. on society, individuals, and institutions) especially concern the desirability and acceptability of an IT artefact. In order to assess these aspects of the IT design, exploring the value systems of relevant stakeholders (developers, users, peers etc.) can help to identify what is desirable. In this regard, while closely linked to the ethical and philosophical realm, the Value Sensitive Design approach [9] provides ways to unveil important values and to transfer them into concrete technological features. The integration of design features, which do not hold high levels of acceptability and desirability, appears to have no practical meaning within an ISDT.

The third quality criteria presented in this paper is formed by the degree of scientific relevance and suitability. An ISDT involves one or more hypotheses, which represent cause-effect relations. In this regard, those design alterations (i.e. design items) appear suitable and theoretically profitable, that promise significant effects. In literature, three dominant ways of identifying design alternatives for the sake of theory building can be detected: (1) intuition and/or experience, (2) derivation from other studies and adaptation, and (3) a mixture of both (see for instance [40]). As mentioned above, design choices are context-bound in most cases, evoking certain effects within specific situations and under specific circumstances. Hence, the adaptation to another context (i.e. a new technological realm with differing use behavior and associated effects) might be inadequate, leading to unintended effects. Therefore, a researcher cannot expect that adapted design items lead to intended (or anticipated) effects. This calls for a more empirical-based foundation.

As a prerequisite of IT design within a certain context (e.g. an enterprise) addressing specific tasks (e.g. decision making), technological expertise and tacit knowledge form the foundation of design-relevant choices. In order to address the quality criteria above, the empirical involvement of context-aware stakeholders, i.e. experts regarding artefact development and its application, appears to be necessary.

## 11.3 Method Development

### 11.3.1 Explorative Approach

Within DSR, the construction and testing of design theories often takes places in connection with novel technological advancements, where the appropriate design choices have not been developed yet. By recognizing this duality of design theory and artefact design, an ISDT, thus, is able to deliver rich insights into the effects the application of an IT artefact will have and how these effects are connected to concrete design features. Here, the utilization of qualitative methods is able to inform the construction of an ISDT based on empirical evidence. Without intending to ignore the value of abduction in design items development, we propose an empirical approach since we argue that ISDT construction particularly lacks the empirical foundation of design items.

In this regard, the focus group research (FGR) approach represents a promising method for a guided and focused exploration while engaging a group of chosen individuals (i.e. relevant stakeholders) from diverse disciplines, each with different inherent values, meanings and attitudes [30, 33]. This approach represents a method for empirical data collection “through group interaction on a topic determined by the researcher” [24]. The topical focus is generated by the goals the participants have in common, for instance, the design of an IT artefact within a joint research project. A focus group session is guided by one or more moderators, who initiate a mutual discussion among the participants through open-ended and narratively stimulating questions [26, 34].

Up to date, the utilization of focus groups as a data generating method is highly underutilized in the Information Systems domain [26, 33]. However, FGR exhibits several strengths, from which DSR researchers and design theorizing can benefit: (1) Group interaction and arising discussion allow for collective reasoning and value generation through mutual negotiation, enabling the emergence of consensus as well as conflicts [26, 30, 33]. (2) FGR can increase the depth of data through surfacing opinions and ideas that would otherwise not be externalized, thus filling individual knowledge gaps and creating a shared space of understanding [8, 33]. (3) The inclusion of minorities within a FGR approach can increase the participants' self-esteem and willingness to take part in the discussion [17]. (4) Utilizing a FGR approach comes with notable economic benefits regarding the time and resources researchers have to invest. In comparison to other methods (e.g. interviews), focus groups are able to produce large amounts of valuable data within short time frames [33]. Before conducting empirical investigations in order to explore promising design features and integrate them into a new ISDT, several prerequisites need to be fulfilled.

Firstly, the purpose and scope of the technological artefact under construction need to be clear. When it comes to designing and testing an IT artefact and its components, researchers and designers operate within a specific context regarding technological (e.g. existing infrastructure) as well as social factors (e.g. use behavior and attitudes towards the artefact) following superordinate goals. Hence, the boundaries of the artefact and the associated ISDT need to be explored and defined. In this regard, the definition of usage scenarios offers theoretical and practical clarity [5]. Scenario building is able to deliver a comprehensive understanding of occurring forms of applications, different stakeholders and user groups, technological and social requirements, as well as conflicts that might arise when it comes to implementing the IT artefact within the targeted context. The latter is particularly important with regard to the ethical aspects of technology design, as these address many possible outcomes, creating a normative reasoning in ISDT building [27]. Secondly and closely linked to scenario building, the acquisition of relevant stakeholders and expertise enables researchers to build normative inquiry based on diverse value systems, experience and (tacit) knowledge in a deliberative manner [27]. From an empirical perspective, by involving relevant experts during the theory construction phase, researchers have access to fundamental knowledge with regard to artefact design and requirements from context-bound perspectives. For instance, a medical practitioner can judge on proposed technology specifications of a system intended to support therapeutic activities from a more context-related perspective (e.g. [1]).

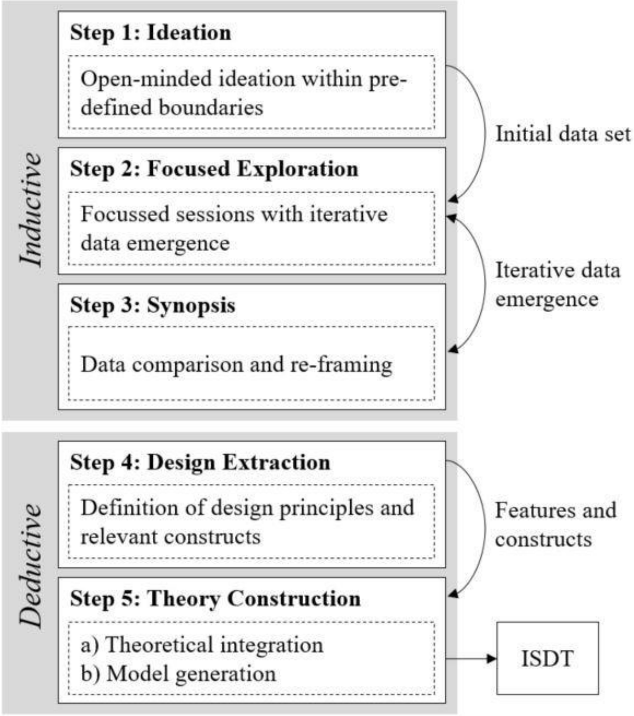


**Figure 1: Theory Development Procedure**

### 11.3.2 Data-driven Design Theory Building

The empirical data generation procedure presented in this paper follows an explorative focus group approach and is presented in Figure 1. The procedure consists of five consecutive steps, involving an inductive (steps 1 to 3) and a deductive phase (steps 4 and 5). The inductive steps serve the purpose of initial, followed by iterative data collection and coding. Subsequently, the deductive steps seek to integrate the gathered data and derived insights within adjacent literature in order to identify valuable kernel theories and relating constructs, followed by the final construction of an ISDT model. Subsequently, the empirical ISDT construction procedure is described. Since design science is an iterative process, the procedure proposed here represents one iteration and merely a part of an overall complex design study.

**Step 1: Ideation.** Within the first methodological step, an open-minded ideation session engaging relevant stakeholders from research and practice takes place in order to unveil an initial set of design requirements and associated expectations, issues, societal impacts etc. Here, a “full group” approach acquiring multiple perspectives and diverse knowledge [10] appears to deliver rich insights, informing further investigations and discussions. The baseline for discussion and discourse initiation is formed by the collection and definition of usage scenarios. In many cases, these scenarios are partly pre-defined due to the predominant project boundaries and technological purpose. Due to the involvement of a broad spectrum of disciplines, each incorporating its own priorities, opinions, and meanings, a rigor moderation is necessary to evoke fruitful discussions and suppress unwanted group dynamics and conflicts [26, 32]. The heterogeneous participant constellation al-lows for interdisciplinary discussion and interaction, stimulating “out-of-the-box” thinking and mutual perspective taking. Uprising concerns regarding potential hazardous design choices (both from a technological and a use-related standpoint) can be dissolved on the spot, enriching the design’s feasibility and acceptability. Following the focus group session, the gathered (transcribed) data is initially coded. This resembles the coding procedure utilized within the Grounded Theory approach [35, 39] and aims at forming a first categorization scheme covering emerged themes.

**Step 2: Focused Exploration.** Following the initial data collection step, the focused exploration encompasses targeted investigations from different perspectives. Here, the themes identified in step 1 form the baseline for further focus group sessions. In order to dive deeper into the respective themes and to reach a high degree of comparability across the involved disciplines, the focused exploration stipulates the conduction of multiple sessions, each involving only stakeholders from one specific domain, following a purposeful sampling procedure [22]. The number of necessary workshops aligns with the quantity of involved parties. These homogeneous groups serve the purpose of illuminating each identified superordinate theme from one specialized point of view, delivering distinct sets of data. Hereby, each session consists of an initial, open-ended phase of a rather narrative nature, discussing each theme impartially. Subsequently, the moderator uses statements from a previous session as a stimulating input for further discussion. This allows for a constant comparison between each session and, thus, stakeholder group, as well as theoretically driven, iterative data emergence. Conflicts, which are identified by the moderator during a session and relate to contradicting statements and opinions, can be addressed on the spot. In this regard, the moderator(s) should be aware of potentially occurring tensions and biases between one or more (sub-)groups [32]. These inter-group biases should be prevented, for instance through an appropriate anonymization.

**Step 3: Synopsis.** The synopsis of data takes place both during and after the conduction of focus group sessions, representing an iterative data analysis. The purpose of this step is to compare spawning data with previous insights and re-frame the theoretical alignment of upcoming sessions accordingly. Throughout the iterative data synopsis, commonalities and conflicts within and between groups can be identified. This constant comparison leads to a recoding of the initial data set and the formation as well as refinement of subcategories [39]. As a result, the initial coding theme is (a) adjusted according to new insights and/or (b) complemented by new superordinate themes and associated subthemes.

**Step 4: Design Extraction.** Representing the first step of the deductive phase, the design extraction step seeks to identify and derive appropriate design principles based on the categorization scheme. Here, the researchers scan the data from a pragmatic (i.e. concrete design features and technological requirements) and a theoretical (i.e. related constructs and variables informing a kernel theory) perspective. This leads to the deductive formulation of design principles (e.g. "Keep users informed about the data captured") and associated constructs (e.g. "system transparency") in consideration of the quality criteria mentioned above (e.g. ethics).

**Step 5. Theory Construction.** The last step of the theory construction procedure consists of two consecutive steps: *(a) Theoretical integration:* Originating in Grounded Theory research, theoretical integration seeks to relate empirical evidence, which has been unearthed through iterative data collection and analysis, to theories and related constructs to be found in literature within the respective research field [35]. This way, researchers are able to identify kernel theories and adjacent constructs that relate to the emerged categories and design principles.

*(b) Model generation:* The final step of the empirical theory building procedure is the construction itself. Identified design principles (i.e. design items) build the design variations. They manifest one or more independent variables. These variables as a part of the kernel theory are constructs found in literature, and/or emerged during iterative data analysis. The dependent variable(s) also originate from pre-existing theories or empirical evidence. After the theoretical model has been developed, it can be empirically evaluated, for instance, by implementing the design variations and testing them in an experiment. In doing so, specific design variations of an artefact are validated by validating the design theory, while the design theory is validated by validating the artefact designs.

## 11.4 Exemplary Application

### 11.4.1 Case Description

The case described to illustrate the proposed design theory construction process is framed by a funded research project. Referring to the prerequisites described in chapter 3.1, the scope and goals of the project, the technological boundaries and usage scenarios, as well as the composition of the participating stakeholders need to be depicted. The project case covers the development of a technical, mobile demonstrator, which is intended to support physiotherapeutic treatments following the so-called "Vojta" approach. The goal of the Vojta treatment is to make essential movement patterns available to the patient who suffers from an impairment of the central nervous system. The practitioner applies pressure to certain zones on the body of the patient, followed by automated physiological movements (e.g. arm movement) and other reactions (e.g. heart rate).

With regard to possible areas of system application, three major usage scenarios involving the system under development have been defined in an early stage of the project: (1) Since in many cases the Vojta treatment is performed by caregivers on the patients, the system is able to assist them with specific feedback (e.g. visual or auditory), guiding them during the session. On the upside, this could alleviate the necessity for clinical visits. (2) The system is collecting rich data during the treatments, capturing the quantity and quality of each session. This allows the physician in charge to control and, thus, improve the therapy progress, ultimately promising better health-related results. In addition, the control function is able to benefit the patients' compliance. (3) Due to its ability to guide users during their treatment sessions, the system can be applied as a teaching tool for apprentices. The technological boundaries are set up by diverse software and hardware components. In order to provide a proper measurement of body movements and relevant bio signals, the system involves depth cameras, a variety of body-worn sensors, and pressure plates the patient can be placed on. As the final prerequisite, the implementation of the described project calls for several disciplines, each exhibiting needed expertise and in-depth knowledge with regard to IT design and development, medicine and physiotherapy, as well as computer and social sciences. Hence, a multi-disciplinary group of 19 stakeholders from different domains has been acquired, covering the mentioned demands while holding individual values, judgments and opinions.

### 11.4.2 Procedure and Findings

**Step 1: Ideation.** The initial ideation took place in form of a “full group” [10] workshop involving all of the 19 participants from the diverse disciplines mentioned above, involving a moderator and a recording clerk. The session took 120 minutes in total. After a brief presentation of the usage scenarios by the moderator in order to establish a common understanding of the system, each participant was asked to write down system requirements and design-relevant issues that come to mind with regard to the system’s future application and its impacts on the users, society, as well as the institutional frame. The individual results were presented in plenary. Simultaneously, the moderator loosely categorized and continuously re-arranged the mentioned topics, visualizing them on a whiteboard. As a result, four main categories emerged as an initial data set. The categories, their definitions, and respective example codes are presented in Table [22].

**Step 2: Focused Exploration.** Following the initial workshop, three subsequent focus group sessions have been conducted. The first session (n=7) incorporated experts from the IT sector, i.e. developers and consultants. A group of computer and social scientists took part in the second workshop (n=6). The last session (n=6) involved physicians and therapists from the medical sector. Representing a “mini group” design [10], each focus group session took 90 minutes. The involvement of a homogeneous group with a shared space of expertise and meaning allowed for deep investigations on the identified categories from specific perspectives. Following the iterative approach, the findings from each session informed the subsequent ones, which fostered a theoretically driven data emergence. This allowed the focus group executives to address diverse or even antagonizing statements and opinions, leading to rich and multifaceted insights.

**Step 3: Synopsis.** The activity of constant data integration and comparison took place between each session and during the retrospective data analysis. By doing so, a comprehensive categorization scheme emerged, covering the initial main categories and the respective subcategories. For the sake of demonstrating the methodology presented in this paper, only one subcategory per main category is described below. The specific subcategories are selected based on (1) their substance regarding concrete design requirements and (2) their ability to inform the design items of an ISDT.

*Individualized guidance (Autonomy):* The system can offer different forms of guidance in accordance with the user’s will to perform treatments autonomously. Low levels of guidance, thus, would allow individual approaches, such as therapeutic handles that work best for this specific user.

*Forms of feedback (Competence):* Different forms of feedback (e.g. audio/video signal, haptic feedback) in reaction to the user's operations are able to foster competence and confidence. Especially subliminal forms (e.g. vibration) can lessen distraction of the user, leading to a more focused treatment potentially increasing learning effects and individual competence.

*Heterogeneity of data (Diversity):* By collecting a vast set of different data and not relying on single measurements, the system becomes applicable by a wider population. For instance, the physiological constitution of the patient (e.g. disembodiment) does not lower the therapy's effectiveness.

*Visualization (Privacy):* The data captured by the system can be visualized and stored in different ways, for instance, using a generic, humanoid model or real video footage. Hence, depending on the user's privacy preferences, sensible data (e.g. face, genital area) can be disguised without losing too much information.

| **Category and Definition** | **Example codes** |
|---|---|
| *Autonomy*: The degree to which the user is able to autonomously control the system. | Increasing dependence on the system; Diffusion of responsibility in case of treatment errors |
| *Competence*: The degree to which the system preserves or increases individual skills. | Handling of system errors by users; False system guidance leading to treatment errors |
| *Diversity*: The degree to which the system is applicable by heterogeneous user groups (age, culture, etc.). | Discrimination through objectification; Reasonableness of system design; Cultural backgrounds |
| *Privacy*: The degree to which the system ensures privacy and data security. | Concerns of caregivers; Confidentiality of sensitive data; Fear of data misuse |

**Table 22: Initial Categorization Scheme**

**Step 4: Design Extraction.** For the sake of simplicity and illustration, two of the subcategories described above are consulted for the design extraction and subsequent theory construction, without denying the other categories' ability to inform further studies and research agendas. Looking at the autonomy and competence categories, the tentative implementation and testing of varying individualization levels of guidance paired with different forms of feedback appears especially fruitful. The feedback, in this case, is provided in reaction to events during the treatment sessions, for example, in order to indicate a false or correct movement and suggest corrective or reinforcing measures accordingly. These measures refer to the system guidance during a session and, thus, can be termed as feedback content, forming a second design principle besides different visualization forms. With regard to the quality criteria of design features described in chapter 2.2, this subcategory exhibits high degrees of feasibility (i.e. easy and economic implementation), acceptability (i.e. low level of interference with norms and values), and scientific suitability. Regarding the design feature's suitability, the context of the system, i.e. support of physiotherapeutic treatments, implies enhanced effects regarding the users' behavior, reactions, and attitudes towards the system. Table [23] contains the resulting exemplary design principles.

| **Subcategory** | **Design principles** |
|---|---|
| Individualized guidance (Autonomy) | No guidance (system gives no advice)<br>Standardized guidance (advice based on standard treatment procedures)<br>Individualized guidance (advice based on individual patient and previous sessions) |
| Forms of feedback (Competence) | Visual signal (e.g. LED light or screen notification)<br>Auditory signal (e.g. sound signal or human voice)<br>Haptic signal (e.g. vibration of a body-worn device) |

**Table 23: Exemplary Design Principles**

Since the therapeutic treatments are of a haptic nature and require manual operations (e.g. applying pressure to the patient's body), feedback in form of vibration appears to have significant effects on the way people apply the treatment. The comparison with other forms of feedback such as light or voice signals in combination with alternating levels of individualized guidance suggests meaningful experimental results.

**Step 5: Theory Construction.** At this point, several findings emerged that constitute potential components of the ISDT under construction. Firstly, autonomy and competence represent theoretical and normative constructs that have already been subject to numerous studies in IS research and other disciplines, thus opening up a wide field of theoretical anchor points. Secondly, the defined design principles provide the design items of an ISDT.

*(a) Theoretical integration:* Looking at research studies on competence and the establishment of medical skills (e.g. the proper execution of a therapy session by a novice or layperson), the trend of using technological devices such as simulators within medical education becomes evident. Over time, the reduction of medical errors in order to increase patient safety has become more important. Additionally, today's outcome-based education styles call for new ways of competence assessment, which technologies are able to deliver [31]. Medical simulators allow novices to practice and master certain techniques and procedures as well as ways to assess different kinds of competence, following the framework for clinical assessment [23]. With regard to learning and the acquisition of skills and knowledge, recent studies payed much attention on how to design multimedia learning material and the way it is presented to the learner in order to increase learning performance and outcomes (see for instance [20]). A promising theoretical concept that has been utilized throughout studies is Media Richness Theory (MRT), originating in organizational learning [4]. The theory "makes predictions about behavior and outcomes in connection with various communication media", classifying different media "according to their degree of richness" [18] (p. 11). MRT proposes that the provision of multiple communication channels (here: between system and user) will lead to choosing the most suitable channel available when it comes to solving tasks. On the opposite, it is stated that the constraint of media to choose from will lead to quality losses of task outcomes [18].

*(b) Model generation:* Within the context of the case study, the induced design principles inform different levels of media richness, implying a high suitability of MRT as a kernel theory. As a dependent variable, learning outcome highly suits the therapeutic setting and the presented usage scenarios, while being perceived as a normative and desirable effect.

Figure 2 illustrates the resulting explanatory ISDT, incorporating the identified design principles operationalizing two independent variables derived from empirical data and associated literature. The measurement model exemplary encompasses generic measurements covering objective (which need to be adapted to the individual context) and subjective measures for learning performance and outcome. The deployment of a suitable measurement model, though, is a task within the actual experimental theory-testing set-up. Based on the model developed, nine different design variations of the artefact can be implemented and evaluated. Taking the results into account, the "optimal" design variation can improve the artefact and form the basis for the next design iteration.

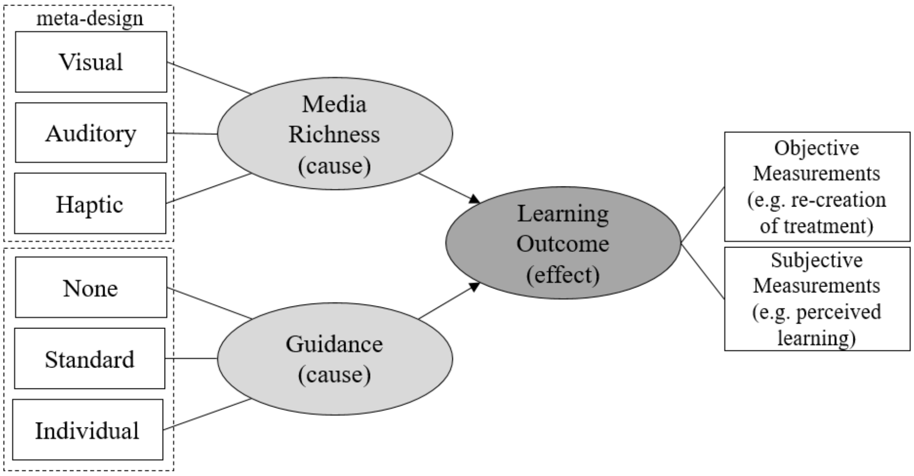


**Figure 2: Resulting Exemplary Design Theory**

### 11.5 Conclusion

*Theoretical and practical implications.* The initial step towards a framework, which allows for the inclusion of explorative, qualitative research methods to enrich the development process of an ISDT with empirical data presented in this paper exhibits several contributions to theory and practice. It contributes to a dual perspective on design theory and artefact design, in which theory and artefact evaluation go hand in hand. From a theoretical perspective, the paper contributes to the body of knowledge regarding design theorizing in DSR. The presented approach enables researchers to go beyond intuition and literature when it comes to develop new design theories. An empirical approach to set up design principles and associated constructs is able to improve the different design variations within an ISDT from multiple perspectives (e.g. societal, technological, and economical). The method is highly suitable within situative and specific contexts (e.g. joint research projects), satisfying particular requirements while addressing occurring and otherwise overlooked issues. When it comes to analyzing data and deriving design features and constructs, the resulting ISDTs have an immediate impact on the respective bodies of knowledge, informing further studies and illuminating effects IT artefacts exert on institutions and users. By empirically founding the design features within a design theory and testing them in an experimental setting, identified cause-effect relations and associated designs exhibit greater relevance for the implementation of the IT artefact. The practical advice an ISDT gives on which design features perform “best” regarding theoretical constructs is rooted in context-bound evidence and expertise, possibly leading to an advantageous IT deployment and adoption. Empirically constructed design theories inform feasible, desirable, and effective technology designs, easing operative decision making.

*Methodological limitations.* The methodological approach presented in this paper exhibits certain limitations. A major one is constituted by the data collection method itself, i.e. the focus group approach. Researchers have pointed out several issues when it comes to conducting and analyzing focus group sessions. On the one hand, partial or full conformity might occur during sessions based on the opinions, priorities, and views of dominant participants [32]. The resulting formation of sub-groups and related group dynamics can, thus, suppress individual views, the voice of minorities, as well as controversial opinions [24]. This might get reinforced with regard to normative discourses during sessions, which are prone to annihilate views that are contrary to perceived norms [32]. On the other hand, the trustworthiness, reliability and, thus, generalizability and external validity of findings might appear questionable, for instance due to idiosyncratic, off-the-cuff statements [7, 16]. These limitations and issues require specific handling by the researcher(s), both from a pragmatic (i.e. moderator behavior during the session) and an analytic (i.e. interpreting the data) perspective [32].

*Outlook.* The paper at hand opens up several promising research opportunities and calls for supplementary method elaboration in order to achieve a methodological framework based on scientific rigor. Firstly, a further development of the presented approach utilizing complementary methods and data sources appears fruitful. Through a rigorous comparison of different methodological approaches and their suitability for inducing a theoretical baseline with regard to a technology design, the case of empirical design theory construction can be enriched, antagonizing some of the limitations of a pure focus group approach and, thus, profiting from inter-method synergies. Secondly, the triangulation of emerging empirical evidence with other data such as adjacent use cases seems promising. For instance, objective usage data derived from log-files or large-scale survey results capturing a variety of opinions and requirements are inclined to deliver more robust findings, allowing accurate and viable design theories to emerge. Thirdly, further method application in other projects enables its advancement and refinement, since underlying common goals of project members might evoke biases.

*Acknowledgements*. This article was supported by the SenseVojta project granted by the German Federal Ministry of Education and Research (BMBF) (No. 13GW0166E).

### 11.6 References

[1] Aggarwal, D., W. Zhang, T. Hoang, B. Ploderer, F. Vetere, and M. Bradford, “SoPhy: A Wearable Technology for Lower Limb Assessment in Video Consultations of Physiotherapy”, Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems, ACM Press (2017), 3916–3928.

[2] Baskerville, R., and J. Pries-Heje, “Explanatory design theory”, Business & Information Systems Engineering 2(5), 2010, pp. 271–282.

[3] Bybee, M., “Abductive inferences and the structure of scientific knowledge”, Argumentation 10(1), 1996, pp. 25–46.

[4] Daft, R.L., and R.H. Lengel, “Organizational information requirements, media richness and structural design”, Management science 32(5), 1986, pp. 554–571.

[5] De Jouvenel, H., “A Brief Methodological Guide to Scenario Building”, Technological Forecasting and Social Change 65(1), 2000, pp. 37–48.

[6] Dew, N., “Abduction: a pre-condition for the intelligent design of strategy”, Journal of Business Strategy 28(4), 2007, pp. 38–45.

[7] Eisenhardt, K.M., and M.E. Graebner, “Theory building from cases: Opportunities and challenges”, Academy of management journal 50(1), 2007, pp. 25–32.

[8] Eysenbach, G., “Recent advances: Consumer health informatics”, BMJ: British Medical Journal 320(7251), 2000, pp. 1713.

[9] Friedman, B., P.H. Kahn Jr, A. Borning, and A. Huldtgren, “Value sensitive design and information systems”, In Early engagement and new technologies: Opening up the laboratory. Springer, Dordrecht, 2013, 55–95.

[10] Greenbaum, T.L., The handbook for focus group research, Sage, 1998.

[11] Gregor, S., “Building theory in the sciences of the artificial”, ACM (2009), 4.

[12] Gregor, S., and D. Jones, “The anatomy of a design theory”, Journal of the Association for Information Systems 8(5), 2007, pp. 312.

[13] Gregory, R.W., and J. Muntermann, “Research Note—Heuristic theorizing: Proactively generating design theories”, Information Systems Research 25(3), 2014, pp. 639–653.

[14] Hevner, A., S.T. March, J. Park, and S. Ram, “Design science in information systems research”, MIS quarterly 28(1), 2004, pp. 75–105.

[15] Judi, H.M., A. Razak, N. Sha'ari, and H. Mohamed, "Feasibility and critical success factors in implementing telemedicine", Information Technology Journal 8(3), 2009, pp. 326–332.

[16] Kidd, P.S., and M.B. Parshall, "Getting the focus and the group: enhancing analytical rigor in focus group research", Qualitative health research 10(3), 2000, pp. 293–308.

[17] Kitzinger, J., "Qualitative research. Introducing focus groups.", BMJ: British medical journal 311(7000), 1995, pp. 299.

[18] Kock, N., "Information systems theorizing based on evolutionary psychology: an interdisciplinary review and theory integration framework", Mis Quarterly, 2009, pp. 395–418.

[19] Kuechler, W., and V. Vaishnavi, "A framework for theory development in design science research: multiple perspectives", Journal of the Association for Information systems 13(6), 2012, pp. 395.

[20] Liu, S.-H., H.-L. Liao, and J.A. Pratt, "Impact of media richness and flow on e-learning technology acceptance", Computers & Education 52(3), 2009, pp. 599–607.

[21] March, S.T., and G.F. Smith, "Design and natural science research on information technology", Decision support systems 15(4), 1995, pp. 251–266.

[22] Marshall, M.N., "Sampling for qualitative research", Family practice 13(6), 1996, pp. 522–526.

[23] Miller, G.E., "The assessment of clinical skills/competence/performance.", Academic medicine 65(9), 1990, pp. S63-7.

[24] Morgan, D., Focus Groups as Qualitative Research, SAGE Publications, Inc., 2455 Teller Road, Thousand Oaks California 91320 United States of America, 1997.

[25] Niehaves, B., and K. Ortbach, "The inner and the outer model in explanatory design theory: the case of designing electronic feedback systems", European Journal of Information Systems 25(4), 2016, pp. 303–316.

[26] O'hEocha, C., X. Wang, and K. Conboy, "The use of focus groups in complex and pressurised IS studies and evaluation using Klein & Myers principles for interpretive research: Evaluate an applied focus group approach using Klein & Myers principles", Information Systems Journal 22(3), 2012, pp. 235–256.

[27] Owen, R., J. Stilgoe, P. Macnaghten, M. Gorman, E. Fisher, and D. Guston, "A framework for responsible innovation", Responsible innovation: managing the responsible emergence of science and innovation in society, 2013, pp. 27–50.

[28] Peffers, K., T. Tuunanen, M.A. Rothenberger, and S. Chatterjee, “A design science research methodology for information systems research”, Journal of management information systems 24(3), 2007, pp. 45–77.

[29] Pot, A.M., B.M. Willemse, and S. Horjus, “A pilot study on the use of tracking technology: Feasibility, acceptability, and benefits for people in early stages of dementia and their informal caregivers”, Aging & Mental Health 16(1), 2012, pp. 127–134.

[30] Powell, R.A., and H.M. Single, “Focus groups”, International journal for quality in health care 8(5), 1996, pp. 499–504.

[31] Scalese, R.J., V.T. Obeso, and S.B. Issenberg, “Simulation Technology for Skills Training and Competency Assessment in Medical Education”, Journal of General Internal Medicine 23(S1), 2008, pp. 46–49.

[32] Smithson, J., “Using and analysing focus groups: limitations and possibilities”, International journal of social research methodology 3(2), 2000, pp. 103–119.

[33] Stahl, B.C., M.C. Tremblay, and C.M. LeRouge, “Focus groups and critical social IS research: how the choice of method can promote emancipation of respondents and researchers”, European Journal of Information Systems 20(4), 2011, pp. 378–394.

[34] Stewart, D.W., and P.N. Shamdasani, Focus groups: Theory and practice, Sage publications, 2014.

[35] Urquhart, C., H. Lehmann, and M.D. Myers, “Putting the ‘theory’ back into grounded theory: guidelines for grounded theory studies in information systems: Guidelines for grounded theory studies in information systems”, Information Systems Journal 20(4), 2009, pp. 357–381.

[36] Venkatesh, V., M.G. Morris, G.B. Davis, and F.D. Davis, “User acceptance of information technology: Toward a unified view”, MIS quarterly, 2003, pp. 425–478.

[37] Walls, J.G., G.R. Widmeyer, and O.A. El Sawy, “Building an information system design theory for vigilant EIS”, Information systems research 3(1), 1992, pp. 36–59.

[38] Wang, W., Y. Zhao, L. Qiu, and Y. Zhu, “Effects of Emoticons on the Acceptance of Negative Feedback in Computer-Mediated Communication”, Journal of the Association for Information Systems 15(8), 2014, pp. 454–483.

[39] Wiesche, M., M.C. Jurisch, P.W. Yetton, and H. Krcmar, “Grounded Theory Methodology in Information Systems Research”, MIS Quarterly 41(3), 2017, pp. 685–701.

[40] Zhu, L., I. Benbasat, and Z. Jiang, “Let’s Shop Online Together: An Empirical Investigation of Collaborative Online Shopping Support”, Information Systems Research 21(4), 2010, pp. 872–891.

# 12 Influence of Information Incongruity on Trust-Relations

| | |
|---|---|
| Title | **Investigating the Influence of Information Incongruity on Trust-Relations within Trilateral Healthcare Settings** |
| Number | **P6** |
| Authors | Marius Müller[1]<br>Oliver Heger[1]<br>Bastian Kordyaka[1]<br>Björn Niehaves[1]<br><br>[1]University of Siegen<br>Kohlbettstraße 15<br>57072 Siegen |
| Publication Type | Conference Proceedings |
| Publication Outlet | Internationale Tagung Wirtschaftsinformatik |
| Status | published |
| Full Citation | Mueller, M., Heger, O., Kordyaka, B., Niehaves, B. (2019), "Investigating the Influence of Information Incongruity on Trust-Relations within Trilateral Healthcare Settings", 14. Internationale Tagung Wirtschaftsinformatik (WI 2019), Siegen, Germany. |

**Table 24: Publication Overview (P6)**

# Investigating the Influence of Information Incongruity on Trust-Relations within Trilateral Healthcare Settings

*Abstract*: Modern health information technologies (HIT) come with many benefits for healthcare, such as a decrease of necessary clinical visits or independent health monitoring. The deployment of these technologies to support medical treatments expands the traditional patient-physician relationship to a trilateral setting involving patient, physician, and HIT. Whereas patients formerly relied on health-related information given by their physician, the digitization of healthcare as well as increasing levels of individual health literacy represent new sources of information and, thus, call for investigating different forms of trust towards medical experts, technologies, and the patient's own judgements. Information incongruities, however, can lead to new forms of trust issues, thus calling for dedicated research. We propose a vignette study in the form of an online survey to investigate the influence information incongruities can have on different forms of patient-sided trust. For this, we develop hypotheses representing our expected results.

*Keywords*: HIT, Trust, Information Incongruity, Health Literacy, Self-efficacy

## 12.1 Introduction

Traditional healthcare settings involve relationships between patients and one or more medical experts such as primary care physicians that are largely based on interpersonal trust, empathy, and satisfaction with treatments [1]. Patient-sided trust in physicians leads to compliance with instructions, assessments, and advices [2], which in turn increases the effectiveness of medical treatments. Whereas traditional patient-physician relationships evolve around the patient following and complying with recommendations and judgements made by the physician, a deliberative relationship model emerged throughout the last decades that calls for a higher degree of patient participation and autonomy regarding clinical processes [3, 4]. This autonomous and deliberative stance becomes more important in the light of modern developments and deployments of technologies for healthcare, often referred to as health IT (HIT) [5].

The implementation of HIT within medical processes and, thus, patient-physician relationships introduces a new source of health-related information. Hence, the medical setting becomes more complex and new relationships are formed. On the one hand, patients interact with mobile, self-managed HIT systems [6] or more complex ones that are deployed in their home environment [7, 8]. For example, they are enabled to autonomously retrieve information about their health status and the potential need for interventions. Wearable sensors, for instance, can measure the patient's heart rate and cardiac status throughout the day [9]. On the other hand, physicians deploy HIT systems to support patient care, to reduce the number of face-to-face meetings through health status monitoring (gathered by wearable sensors or patient input), or to mediate therapeutic instructions using telemedical tools such as live video sessions [10]. Hence, HIT represents a new 'actor' within healthcare settings, enabling new forms of interaction. A transition from bilateral to trilateral relationships becomes apparent.

However, by dissolving former power-imbalances between patients and physicians through HIT deployment, these new forms of relationships are prone to deteriorations, for instance evoked by informational gaps and differing outcome expectations between patients, experts, and technologies [11]. Since HIT systems represent an additional source of health-related information, new issues arise. The HIT's behaviour and output might contradict the information the patient or physician have, which potentially evokes questions on whether the patient or physician might be wrong in their assessment [11]. This, in turn, might deteriorate prevalent trust-relations. From a patient perspective, three trust-forming relations can be identified, which are trust in the physician [1], trust in the HIT [12], and trust in oneself (regarding knowledge and actions) [13]. A decrease in trust can originate from different forms of information incongruity and resulting skepticism towards the source of information trusted the least [12]. As suggested by Cognitive Balance Theory, imbalances within a trilateral setting (e.g. patient trusts physician and HIT but physician and HIT contradict each other) lead to discomfort [14].

This study's goal is to shed light on the emergence of trust issues within trilateral healthcare settings evoked by information incongruity between involved actors, which delivers implications for HIT design and solutions to hamper the deterioration of trust. Consequently, this study is guided by the following research question (RQ):

**RQ:** *How do information incongruities within a trilateral healthcare setting influence patient-sided forms of trust (trust in physician, a HIT, and in oneself)?*

## 12.2 Trust in Physician, HIT, and Oneself

Trust is the willingness of people to be exposed in risky situations [15] and depend on another party [16]. From the patient's perspective within the trilateral setting, trust is their willingness to depend their health on 1) the physician, 2) the health information technology, and 3) their own health knowledge and capabilities.

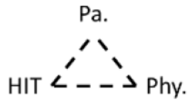
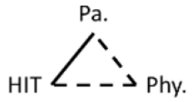
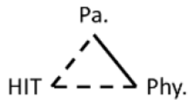
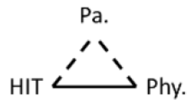
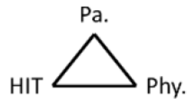
Trust between a patient and a physician depends on many factors. Among others, significant drivers of interpersonal trust within a patient-physician relationship are perceived empathy, the patient's satisfaction with courses and outcomes of treatments [1], patient-centered communication [17], and autonomy [18] as well as perceived control [19]. Patient-sided trust in recommendations, treatment instructions, and overall assessments made by a physician is expressed through the patient's compliance [2]. Non-compliance can interfere with the patient's health and therapeutic efforts [20]. As a result, the effectiveness and outcome of therapies and medical treatments greatly depend on this relationship and emerging trust-relations.

Besides trust in the human expert, trust in HIT itself plays a role in shaping the trilateral setting. Trusting beliefs in a specific technology is shaped by trust in its functionality, reliability, and helpfulness [21]. The formation of trusting beliefs in IT can be explained by ease of use, system quality perceptions, uncertainty avoidance culture, and institution-based trust [22]. Furthermore, the formation of trust in technology is influenced by the performance, process, and purpose of the IT artifact itself [23]. Trust is not only a desirable condition within a medical setting itself, but an important precondition for a successful adoption of "risky" and novel technologies [24].

The third trust relationship of interest is the patients' trust in their own competence to assess the appropriateness of a medical treatment and/or to carry out the medical treatment by themselves (e.g. physiotherapeutic activities at home). This trust relationship can be represented by the constructs of 'self-efficacy' and 'health literacy'. Self-efficacy deals with one's "judgment of their capabilities to organize and execute courses of action required to attain designated types of performance" [25] (p. 391). Studies indicate that self-efficacy related to health practices shows strong relationships with health behavior [13]. Besides this, computer self-efficacy could additionally play a significant role within the trilateral setting, since the patient is expected to use technology [26]. Similarly but from a more dispositional perspective, health literacy is “the ability to understand and interpret the meaning of health information in written, spoken or digital form” [27] (p. 144). Health literacy is an essential factor when it comes to the deployment of HIT, since their success depends on the effective communication with different audiences, who have unique needs and capacities [28].

### 12.3 Hypotheses

Based on the trilateral setting including patient, HIT, and physician, we derived the following hypotheses (Table [25]):

| **Hypothesis** | **Illustration** |
|---|---|
| **H1:** Information incongruity between patient, HIT and physician negatively influences trust in patient, HIT, and physician. |  |
| **H2a:** Information congruity between patient and HIT and information incongruity between patient or HIT and physician negatively influences trust in physician. |  |
| **H2b:** Information congruity between patient and physician and information incongruity between patient or physician and HIT negatively influences trust in HIT. |  |
| **H2c:** Information congruity between HIT and physician and information incongruity between HIT or physician and patient negatively influences trust in patient (self-efficacy). |  |
| **H3:** Information congruity between patient, HIT and physician positively influences trust in patient, HIT, and physician. |  |

*Pa. = Patient, Phy. = Physician; solid = congruent, dashed = incongruent*

**Table 25: Hypotheses**

## 12.4 Method and Outlook

To empirically test our hypotheses, we plan to conduct a between-subjects vignette study with an online survey given out to a self-selected convenient sample consisting of patients. To acquire a sample of sufficient size, we distribute the survey link via a network of regional primary care physicians as well as via social media. Each of the five conditions within the trilateral setting (cf. Table [25]) is represented by two vignettes. To ensure external validity, we interview primary care physicians in a preliminary step. In doing so, we aim for constructing viable vignettes that depict common treatment scenarios that often occur among patients with chronic conditions. Since trust forms over time, the investigation of such conditions seems promising. Hence, we target participants who have experienced chronic treatments.

We aim for constructing two vignettes. The first vignette describes a scenario in which the participant is instructed by a HIT to take pills and receives congruent (or incongruent) information. The second vignette describes a more complex scenario in which the participant has to carry out a physiotherapeutic exercise. Following each vignette, the participant has to answer the same questionnaire. The two vignettes are presented in a random order. The reasons for presenting two vignettes per condition is to account for external validity and to alter the degree of scenario complexity, since trust is especially relevant in complex situations [29].

For the questionnaire, we plan to adapt the eleven items of the “Trust in Physician Scale” [19] to measure interpersonal trust between participants and the physician. For the participants’ trust in HIT, we adapt the eleven “Trust Belief in Specific Technology” items from McKnight et al. [21]. For participants’ trust in themselves, we adapt relevant items from the SRAHP scale [30] and the European Health Literacy Questionnaire (HLS-EU-Q) [31]. We further include demographic and control variables. For data analysis, we plan to conduct three separate 2 (simple vs. complex scenario) x 5 (trilateral trust settings depicted in Table [25]) mixed ANOVAs with complexity as within-subject factor, information congruity as between-subject factor, and the three forms of trust (trust in physician, the HIT, and in oneself) as dependent variables.

Based on the results of this study, we plan to derive and empirically evaluate technology design implications to deal with the matter of trust. Although the trilateral setting described in this paper is a simplified model, we believe that considering potential information incongruities in the design of health information technologies will increase trust in and the acceptance of digital healthcare interventions.

## Acknowledgements

This research is supported by the SenseVojta project granted by the German Federal Ministry of Education and Research (BMBF) (No. 13GW0166E).

## 12.5 References

1. Hojat, M., Louis, D.Z., Maxwell, K., Markham, F., Wender, R., Gonnella, J.S.: Patient perceptions of physician empathy, satisfaction with physician, interpersonal trust, and compliance. International Journal of Medical Education. 1, 83–87 (2010)
2. Kim, S.S., Kaplowitz, S., Johnston, M.V.: The Effects of Physician Empathy on Patient Satisfaction and Compliance. Evaluation & the Health Professions. 27, 237–251 (2004)
3. Brody, D.S.: The patient's role in clinical decision-making. Annals of Internal Medicine. 93, 718–722 (1980)
4. Emanuel, E.J., Emanuel, L.L.: Four models of the physician-patient relationship. JAMA. 267, 2221–2226 (1992)
5. Goldschmidt, P.G.: HIT and MIS: implications of health information technology and medical information systems. Communications of the ACM. 48, 68–74 (2005)
6. Cafazzo, J.A., Casselman, M., Hamming, N., Katzman, D.K., Palmert, M.R.: Design of an mHealth app for the self-management of adolescent type 1 diabetes: a pilot study. Journal of Medical Internet Research. 14, e70 (2012)
7. Tang, R., Yang, X.-D., Bateman, S., Jorge, J., Tang, A.: Physio@Home: Exploring Visual Guidance and Feedback Techniques for Physiotherapy Exercises. In: Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems. pp. 4123–4132. ACM Press, Seoul, Republic of Korea (2015)
8. Tetteroo, D., Vreugdenhil, P., Grisel, I., Michielsen, M., Kuppens, E., Vanmulken, D., Markopoulos, P.: Lessons Learnt from Deploying an End-User Development Platform for Physical Rehabilitation. In: Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems. pp. 4133–4142. ACM Press, Seoul, Republic of Korea (2015)
9. Pantelopoulos, A., Bourbakis, N.G.: A Survey on Wearable Sensor-Based Systems for Health Monitoring and Prognosis. IEEE Transactions on Systems, Man, and Cybernetics, Part C (Applications and Reviews). 40, 1–12 (2010)

10. Kvedar, J., Coye, M.J., Everett, W.: Connected health: a review of technologies and strategies to improve patient care with telemedicine and telehealth. Health Affairs. 33, 194–199 (2014)

11. Van Woerkum, C.M.: The Internet and primary care physicians: coping with different expectations. The American Journal of Clinical Nutrition. 77, 1016–1018 (2003)

12. Hesse, B.W., Nelson, D.E., Kreps, G.L., Croyle, R.T., Arora, N.K., Rimer, B.K., Viswanath, K.: Trust and sources of health information: the impact of the Internet and its implications for health care providers: findings from the first Health Information National Trends Survey. Archives of internal medicine. 165, 2618–2624 (2005)

13. Strecher, V.J., McEvoy DeVellis, B., Becker, M.H., Rosenstock, I.M.: The role of self-efficacy in achieving health behavior change. Health education quarterly. 13, 73–92 (1986)

14. Heider, F.: The psychology of interpersonal relations. John Wiley & Sons Inc., Hoboken, NJ, US (1958)

15. Gefen, D., Straub, D.W.: The relative importance of perceived ease of use in IS adoption: A study of e-commerce adoption. Journal of the Association for Information Systems. 1, 8–37 (2000)

16. Rousseau, D.M., Sitkin, S.B., Burt, R.S., Camerer, C.: Not so different after all: A cross-discipline view of trust. Academy of management review. 23, 393–404 (1998)

17. Epstein, R.M., Franks, P., Fiscella, K., Shields, C.G., Meldrum, S.C., Kravitz, R.L., Duberstein, P.R.: Measuring patient-centered communication in patient–physician consultations: theoretical and practical issues. Social science & medicine. 61, 1516–1528 (2005)

18. Lee, Y.-Y., Lin, J.L.: Do patient autonomy preferences matter? Linking patient-centered care to patient–physician relationships and health outcomes. Social science & medicine. 71, 1811–1818 (2010)

19. Anderson, L.A., Dedrick, R.F.: Development of the Trust in Physician scale: a measure to assess interpersonal trust in patient-physician relationships. Psychological reports. 67, 1091–1100 (1990)

20. Roter, D.L., Hall, J.A., Merisca, R., Nordstrom, B., Cretin, D., Svarstad, B.: Effectiveness of interventions to improve patient compliance: a meta-analysis. Medical care. 36, 1138–1161 (1998)

21. Mcknight, D.H., Carter, M., Thatcher, J.B., Clay, P.F.: Trust in a specific technology: An investigation of its components and measures. ACM Transactions on Management Information Systems (TMIS). 2, 12 (2011)
22. Vance, A., Elie-Dit-Cosaque, C., Straub, D.W.: Examining trust in information technology artifacts: the effects of system quality and culture. Journal of management information systems. 24, 73–100 (2008)
23. Söllner, M., Hoffmann, A., Hoffmann, H., Wacker, A., Leimeister, J.M.: Understanding the formation of trust in IT artifacts. In: Proceedings of the 33rd International Conference on Information Systems. , Orlando, USA (2012)
24. Fukuyama, F.: Trust: The social virtues and the creation of prosperity. Free Press Paperbacks, NY (1995)
25. Bandura, A.: Social foundations of thought and action. Englewood Cliffs, NJ. 1986, (1986)
26. Compeau, D.R., Higgins, C.A.: Computer Self-Efficacy: Development of a Measure and Initial Test. MIS Quarterly. 19, 189–211 (1995)
27. Adams, R.J., Stocks, N.P., Wilson, D.H., Hill, C.L., Gravier, S., Kickbusch, L., Beilby, J.J.: Health literacy-a new concept for general practice? Australian family physician. 38, 144–147 (2009)
28. Kreps, G.L.: The relevance of health literacy to mHealth. Information Services & Use. 37, 123–130 (2017)
29. Luhmann, N.: Trust and power. John Wiley and Sons, Inc., Chichester, UK (1979)
30. Becker, H., Stuifbergen, A., Oh, H.S., Hall, S.: Self-rated abilities for health practices: A health self-efficacy measure. Health Values: The Journal of Health Behavior, Education & Promotion. 17, 42–50 (1993)
31. Sørensen, K., Van den Broucke, S., Pelikan, J.M., Fullam, J., Doyle, G., Slonska, Z., Kondilis, B., Stoffels, V., Osborne, R.H., Brand, H.: Measuring health literacy in populations: illuminating the design and development process of the European Health Literacy Survey Questionnaire (HLS-EU-Q). BMC Public Health. 13, 948 (2013)

# 13 Cognitive Bias in Technology Acceptance by Physicians

| | |
|---|---|
| Title | **Exploring the Role of Cognitive Bias in Technology Acceptance by Physicians** |
| Number | **P7** |
| Authors | Marius Müller[1]<br>Frederike Marie Oschinsky[1]<br>Henrik Freude[1]<br>Caroline Reßing[1]<br>Michael Knop[1]<br><br>[1]University of Siegen<br>Kohlbettstraße 15<br>57072 Siegen |
| Publication Type | Conference Proceedings |
| Publication Outlet | International Conference on Information Systems |
| Status | published |
| Full Citation | Mueller, M., Oschinsky, F., Freude, H., Reßing, C., Knop, M. (2019), “Exploring the Role of Cognitive Bias in Technology Acceptance by Physicians”, 40th International Conference on Information Systems (ICIS 2019), Munich, Germany. |

**Table 26: Publication Overview (P7)**

# Exploring Emerging Patient Responsibilities in Telemedicine Use: An Empirical Study

*Abstract*: The healthcare domain faces arising challenges. Caused by an ageing society, inequitable access to primary care, and the increasing demand physicians face, the digitization of medical processes emerges as a promising measure. The application of information technologies enables physicians to treat more patients while maintaining quality. Hence, physicians are potentially obliged to implement such technologies and acquire the needed skills to use them. Questions arise on what factors predict their IT acceptance behavior. Literature on technology acceptance broadly looked at technical features and assumed rational behavioral outcomes regarding perceived efforts and benefits of IT use, neglecting psychological aspects such as cognitive biases that inhibit rational decision-making. We propose a mixed-methods study to develop an integrated theoretical model based on the 'Status Quo Bias Perspective'. In order to provide a holistic view on physicians' technology acceptance and intentions, we further compare our tested model with established acceptance theories in IS research.

*Keywords*: Bounded Rationality, Technology Acceptance, Status Quo Bias Perspective, Cognitive Bias, Mixed Methods, Healthcare

## 13.1 Introduction

Over the last decades, the healthcare domain has undergone major changes. Due to several shortcomings in today's healthcare systems, the need for improving clinical, primary care, and therapeutic processes arises in order to safeguard comprehensive care while maintaining service quality and patient satisfaction. The aging society and associated health issues (Demiris and Hensel 2008), paired with a decline in availability of primary and clinical care resulting in rural undersupply and inequitable distribution (Wilson et al. 2009), lead to increasing demands and challenges in the near future. This puts increasing pressure on practicing healthcare professionals, since they are confronted with higher per capita demands while supply declines. More than ever, technologies are seen as a promising way to antagonize health-related disadvantages and societal risks emerging from deficient care (Martínez et al. 2004). Hence, one major driver is the increasing digitization of healthcare practices and treatments. Former analogous medical practices become more and more augmented by technologies, for instance in the form of digital communication channels between healthcare providers and patients, creating more spatial and temporal independence (Kvedar et al. 2014), or the collection of vital parameters through mobile sensory equipment (Pantelopoulos and Bourbakis 2010). These developments promise a relief of physicians, who are enabled to treat larger amounts of patients while maintaining quality and safety (Karsh et al. 2010). Researchers looked at digitized healthcare practices and support from different perspectives, such as patients, caregivers, and medical professionals in therapy, primary care, and clinical medicine. The healthcare and medical domain exhibits a strong culture, social roles and identities physicians acquire as well as societal expectations towards their profession (Cruess and Cruess 2008). Aggravatingly, adoption rates of health IT in healthcare are low (Karsh et al. 2010). This calls for investigations looking at physicians' attitudes towards this technological shift as well as their IT acceptance and use patterns.

One major factor that has been subject to many studies in IS research over the last thirty years is technology acceptance, often measured by constructs like 'intention to use' (Bhattacherjee and Hikmet 2007) or the invers 'resistance towards use' (Hsieh et al. 2014). To accomplish an optimized care in the light of contemporary health-related challenges, technology acceptance (i.e. a behavioral intention) by actors who provide healthcare services is of major importance since it represents a precondition of IT adoption and actual continuous use (Venkatesh and Davis 2000). Studies have investigated technological dimensions of user acceptance and resistance towards adopting and using innovative technologies for healthcare, focussing on properties like 'perceived ease of use' or 'perceived usefulness' (Bhattacherjee and Hikmet 2007). Additionally, former models take claims of rationality as a basis. Constructs like 'effort expectancy' (Venkatesh et al. 2003) imply that there is a calculable trade-off, leading to a specific decision and intention. However, modern and upcoming health technologies are under constant development, rarely applied in standard care, and thus lack medical evidence (Chaudhry et al. 2006). Amongst other, one notable example is the development of applications based on 'Artificial Intelligence' algorithms and procedures. Such applications are expected to support the diagnosis and treatment of diseases in an efficient way, potentially relieving physicians and medical staff. As a result, the usefulness and individual operation of a system becomes hard to measure. Hence, traditional acceptance models fall short in explanatory power, calling for new perspectives looking at psychological factors that potentially explain individuals' use intentions.

One theoretical approach receiving scientific attention in the technology domain are cognitive biases that root in the concept of 'Bounded Rationality' (Kahneman 2003; Kahneman and Tversky 1979; Simon 1955). The concept states that the rationality of decisions individuals make is limited due to cognitive boundaries and informational gaps, opposing the belief in rational decision-making based on weighing off costs and benefits that come with a course of action (i.e. 'homo oeconomicus'). Cognitive biases occur, for instance, in the form of maintaining the status quo (e.g., continuing to use an established IT system) and by this sticking to previous decisions, although there might be better alternatives (Lee and Joshi 2017). Several IS studies utilize cognitive biases in order to explain user behavior when it comes to accepting and adopting new technologies (e.g., Hsieh et al. 2014; Li et al. 2016). While rational decision-making is one defining component of human behavior, these approaches go beyond rational choices and look at bounded rational or even irrational factors that lead to decisions. Thus, human decisions are increasingly seen as an interplay of rational and less rational processes. However, research lacks a common view on what aspects of cognitive bias in decision-making need to be considered when explaining user acceptance, leading to heterogeneous models incorporating various constructs. Further, Lee and Joshi (2017) name several shortcomings of prior studies on cognitive biases in technology acceptance, such as the neglect of 'regret avoidance' forming a user's psychological commitment and the lack of distinction between behavioral and decisional control. Thus, our research is guided by the following research questions (RQs):

**RQ1:** *How can different factors of status quo bias be integrated in a theoretical model?*

**RQ2:** *To what extent can the model explain physicians' behavioral use intentions of health IT?*

**RQ3:** *What is the model's explanatory power compared to established technology acceptance models?*

## 13.2 Theoretical Background

### 13.2.1 Technology Acceptance by Healthcare Professionals

To date, different theoretical approaches have been deployed in order to explain technology acceptance by individuals within the healthcare domain. Technology acceptance plays an important role when it comes to supplementing, substituting, or transforming medical practices through innovative technologies. Looking at the IT acceptance and adoption behavior of healthcare providers and professionals, studies take different perspectives and contexts, such as therapists (Chen and Bode 2011), nurses (Pai and Huang 2011), and physicians (El Halabieh et al. 2017). However, when it comes to the need for comprehensive healthcare supply, the perspective of medical professionals in the form of primary care physicians becomes important. The use of technologies supporting diagnoses, treatments, therapies, and rehabilitation in most cases roots in the physician's initiative and willingness to put effort into implementation and use on a daily basis. A physician's intention to acquire such a technology and the associated decision-making processes depends on many factors and is crucial to the provision of health IT, yet it appears to be elusive and hard to measure (Gewald and Gewald 2017; Lowenhaupt 2004). According to Gewald and Gewald (2017), "we are not aware of any study which is sufficiently and significantly able to really explain why physicians do not show the same adoption behaviour as users in other industries" (p. 3412). Chau and Hu (2002) state, that physicians' decision-making and IT acceptance and adoption behavior differs from users in other domains. Despite being less experienced in the use of technologies, they exhibit great expertise and knowledge regarding their professions. Studies have shown, that physicians are reluctant when it comes to implementing and using IT "that interferes with their traditional routines" (p. 298). In addition, physicians value their degree of autonomy in their work (ibd.). Technology might be seen as a threat to their professional autonomy, which has a negative effect on use intentions (Walter and Lopez 2008).

When looking at theoretical models applied to explain healthcare professionals' IT acceptance, three specific models stand out. First, researcher broadly utilized the 'Technology Acceptance Model' (TAM) and its extended forms to explain acceptance and use behavior in healthcare (Chen and Bode 2011; Chismar and Wiley-Patton 2003; El Halabieh et al. 2017; Pai and Huang 2011). Second, the 'Unified Theory of Acceptance and Use of Technology' (UTAUT) formed the theoretical baseline of many studies on health IT (Kohnke et al. 2014; Samhan 2017; Wills et al. 2008). Third, researchers applied the 'Theory of Planned Behavior' (TPB) as a theoretical lens to investigate technology use intentions (e.g., Chau and Hu 2002). As mentioned above, these 'traditional' acceptance models fall short due to several reasons. Firstly, they do not incorporate dispositional psychological factors such as inertia and loss aversion, which do not necessarily relate to the technology itself but its user. Yet, models like the TAM focus on technical properties of the system under investigation such as 'ease of use' and 'usefulness'

(Venkatesh and Davis 2000), which might apply within evaluative settings but not in prescriptive ones such as the future application of, for example, ‘Artificial Intelligence’ (AI) for diagnostic processes, which might hold great potential for patient treatment when spatial access to care declines. Secondly, they greatly depend on the premise of rationality, for instance in the form of calculable performance and effort trade-offs as suggested by UTAUT (Venkatesh et al. 2003). Rational thoughts, evaluations, and actions form one component of human decision-making and are incorporated in many theoretical approaches. However, a considerable amount of decisions and behaviors is rooted in bounded rationality or even irrationality. Hence, concepts beyond rationality (e.g., cognitive biases) have the potential to deliver further insights on why users behave the way they do. Thirdly, the models’ explanatory power might be weakened in the given context of primary care due to the technologies’ novelty. Modern innovations like AI-based diagnosis support (for instance, calculating a likelihood for certain diseases based on symptoms) are not broadly implemented and used. Use cases and potentials of disruptive technologies like AI within the healthcare domain are still subject to research, medical evidence gathered from clinical trials are scarce if not non-existent (Chaudhry et al. 2006). As a result, innovations lack normative valuation as well as concrete design features and use scenarios in which technology acceptance studies can be conducted. Another issue in research on acceptance and adoption is that “the literature is diffuse, and articles seldom build on earlier ones to increase the theoretical knowledge” (Boonstra et al., 2014, p. 16). The investigation of cognitive biases promises deeper insights on IT acceptance. It can help us to expand our understanding of technology acceptance by physicians and achieve an integrated view on antecedents of use intentions.

### 13.2.2 Status Quo Bias Perspective

Technology acceptance literature implies rational decision making, which assesses relative costs and benefits. It presupposes that users systematically select among possible choices and base their reasoning on facts. However, individuals oftentimes stick with established or familiar decisions, even though alternative information or conditions exist that are objectively superior (Kahneman et al. 1991). Against this background, rational decision-making seems to insufficiently explain the underlying mechanisms of how users evaluate technological change (Kim and Kankanhalli 2009). A promising point of origin for further understanding how users adopt or resist new technology is the stability bias of IS use, which has already been investigated in the context of technology post-adoption (Fleischmann et al. 2014). In specific, the status quo bias perspective (SQBP) provides a novel explanation of user decision making and resistance by advancing the understanding of how users evaluate technology-related change (Kim and Kankanhalli 2009). The approach accounts for cognitive limitations that lead to bounded rationality and helps conceptualize some core IS constructs more accurately (Lee and Joshi 2017).

Samuelson and Zeckhauser (1988) distinguish three dimensions of the people's preference for maintaining their current status or situation. They deduce a) rational decision making, because individuals consider transition costs (e.g., transient costs) and uncertainty costs (e.g., perception of risk) which leaves them fearful and skeptical; b) cognitive misperception, because individuals tend to loom losses greater than gains which makes them to perceive even small losses much larger than given (Kahneman and Tversky 1979); and c) psychological commitment, because previous commitments, prevailing working environments (i.e. social norms) and the desire to be in charge (i.e. control) of individuals leads to feeling unfamiliar and insecure with alternatives. Thus, although implementing a new technology can improve performance, a common reaction to new systems is resistance (Kim and Kankanhalli 2009).

Cognitive stability biases were hardly examined in the health care industry (Fleischmann et al. 2014), although they provide unique insights into 'bias' in human decision-making in its presentation of bounded rationality (Lee and Joshi 2017). To study how physicians evaluate the implementation of new systems, the SQBP understands the impact of maintaining the current status or situation as inhibiting perceptions (e.g., regret avoidance) of using new systems (Hsieh et al. 2014). It provides a useful theoretical explanation for phenomena where individuals disproportionately make decisions to continue an incumbent method rather than switching to a new (potential better) solution (Li et al. 2016). By doing so, we deem SQBP as particularly suitable to understand why many physicians do not intend to use promising technology such as AI. To theoretically understand the failure to switch from an incumbent system to a new one is not derived uniformly, although combined in the SQBP. There are many different approaches using this perspective, but no consensus as to which factor affects which outcome or what dependent variable is at core (Lee and Joshi 2017). For instance, the concept of inertia is on the one hand described to moderate between the dimensions of the bias and use intention (Polites and Karahanna 2012) and on the other hand seen as a sub-dimension of cognitive misperception (Hsieh et al. 2014). Another example is the concept of regret avoidance, which several prior studies seem to oversimplify or exclude (Lee and Joshi 2017). Our work consequently views regret avoidance and social norms as distinct concepts and models them independently. The lack of conceptual clarity opens the door for our explorative approach to study how new technology use is intended or resisted.

### 13.3 Theoretical Foundation for an Integrated Acceptance Model

In order to investigate the SQBP and its main categories within an integrated theoretical approach, their characteristics and relationships regarding IT use intentions by physicians are explained in the following.

**Rational decision-making** refers to a cost-benefit analysis users perform when it comes to using a new technology. Users offset potential costs that accompany adopting the system (e.g. learning efforts) with perceived values (e.g. time savings). Users form an attitude towards the technology influencing their acceptance, thus leaving the status quo (Lee and Joshi 2017). The following constructs play a major role:

*Uncertainty.* Novel technologies impose psychological uncertainty on their users with regard to potential outcomes and risks of using it. To resolve uncertainties, users need to search for system-related information, analyse incurring probabilities, and potentially weigh-off alternatives. Hence, decision making comes with high efforts, which might lead to refraining taking action and maintaining the status quo (Hsieh et al. 2014; Lee and Joshi 2017). Uncertainty thus is expected to be negatively connected with use intentions.

*Transition costs and perceived value.* Transitioning and adapting to the new situation (i.e. using the new system) comes with costs as well. Transient costs refer to the switching process and involved efforts such as learning and getting used to the technology. Permanent costs arise in the longer term after the adoption (such as a loss of service quality due to false use) (Hsieh et al. 2014; Kim and Kankanhalli 2009). Transition costs are supposed to negatively correlate with use intentions, whilst perceived value behaves invers to that.

**Cognitive misperception** describes individual assessments of technology properties and use rooted in research on human decision-making (Kahneman and Tversky 1979). When it comes to making a decision (i.e. adopting a system), cognitive biases can occur due to the overvaluation of properties or potential outcomes. The following constructs describe important forms of cognitive misperceptions:

*Loss aversion.* Users tend to weigh losses greater than gains that come with "risky" decisions (Kahneman and Tversky 1979), in this case to adopt a technology. Perceived efforts relating to implementing a new system can outweigh potential benefits, even though these benefits might exceed efforts. Potential losses originating from leaving the current state are perceived as higher as they might be (Lee and Joshi 2017). Loss aversion thus is expected to be negatively related to use intentions.

*Anchoring effects.* These effects have been widely neglected within prior IS studies (Lee and Joshi 2017). An ‘anchor’ refers to a starting value individuals set as a reference point when assessing upcoming changes. In particular, once the current form of practice evolves into a habit, anchors become much stronger and deteriorate perceived costs and benefits (ibd.). In our case, anchors may be formed by medical practices that do not involve digital technologies, yet, such as measuring a patient’s vital parameters. Thus, comparing ‘non-technical’ anchors with digitized forms of practice represents a challenge in our study while promising novel insights. Stronger anchors might hamper use intentions, implying a negative relationship.

*Inertia.* Polites and Karahanna (2012) define inertia “[…] as attachment to, and persistence of, existing behavioral patterns (some of which are habituated) even if there were better alternatives and incentives to change” (p. 22). In other words, individuals prefer the current or past courses of action and tend to stick to the status quo, “[…] because this is what they have always done […]” (Hsieh et al., 2014, p. 7). High inertia thus lowers use intentions and hampers decision making in favor of IT adoption.

**Psychological commitment** refers to a form of obligation an individual perceives when it comes to substituting courses of action with new ones. Individuals that are highly committed tend to stick to their preferences even in the light of conflicting information regarding potentially higher performing alternatives (Crosby and Taylor 1983), maintaining cognitive consistencies (Pritchard et al. 1999). Hence, individuals stay loyal towards their own actions. The following forms of commitment can explain cognitive biases:

*Sunk cost.* Sunk cost refers to the amount of commitment and efforts by the individual relating to previous decisions and behavior (Samuelson and Zeckhauser 1988). For instance, the level of skill a user had to acquire in order to follow a course of action, e.g. using a technology, is strongly bound to the status quo. When it comes to switching to an alternative (e.g. a new technology) these learning efforts are perceived to get lost (Kim and Kankanhalli 2009). Higher perceived sunk costs thus can hamper use intentions.

*Regret avoidance.* This construct inclines individuals to refrain from decisions that they may regret later on (Lee and Joshi 2017), potentially forming a resisting attitude towards new technologies. Potential regret can further depend on the organization or domain the IT adoption takes place in. The environment of the individual exhibits norms that might influence the way failure is viewed (Kane and Labianca 2011). Domains with a more conservative culture valuate risky decisions as unfavourably, promoting the urge to avoid regrets (Lee and Joshi 2017). High levels of regret avoidance thus might lower use intentions.

*Decisional control.* Control can be viewed from two perspectives. First, decisional control (DC) can be seen "as an individual's authority to control autonomous decision-making" (Lee and Joshi, 2017, p. 746), referring to a pre-adoption process. Second, behavioral control (BC) describes the individual's ability to handle a post-adoption situation. BC refers to the user's self-efficacy, which is often mistakenly used to measure DC (ibd.). Hence, BC and DC must be distinguished. In the context of SQBP, DC forms psychological commitment and is expected to be positively connected with use intentions.

**Organizational and social influences** describe different factors affecting the perception of and individual attitude towards a new technology, holding great potential to further differentiate and explain variables provided by SQBP dimensions. Since many studies that incorporate cognitive biases did not consider these factors (Lee and Joshi 2017), claims for an integrated explanation of user acceptance emerge.

*Social and organizational norms.* When looking at physicians, their decision-making, and adoption behavior, norms occur in different forms and can influence biases towards using a technology (Hu et al. 2011). In our case, norms can be looked at in two ways. Social norms originate from (a) the societal environment and incumbent expectations towards healthcare quality and physician performance (Bauchner 2001; Cruess and Cruess 2008), and (b) other actors within the healthcare domain such as colleagues (Kim and Kankanhalli 2009). Organizational norms depart from individual opinions and are much more based on the culture, tradition, and convictions inherent in the healthcare domain. For instance, large amounts of medical decision-making are based on evidence (Bauchner 2001). However, innovative technologies aiming for supporting medical processes such as patient treatment lack clinical evidence due to their early development state (Chaudhry et al. 2006; Karsh et al. 2006). Thus, the medical community might grade using a novel technology as reprehensible. Norms favouring the use of technology thus are expected to positively correlate with individual use intentions.

*Organizational support.* Kim and Kankanhalli (2009) define organizational control as “the perceived facilitation provided by the organization to make users' adaptation to new IS-related change easier” (p. 573). Hence, organizational support can influence the prevalence of cognitive biases, for instance through provision of resources and training. Studies have shown that organizational support can reduce user resistance towards change (Huang 2015), thus implying a positive effect on use intentions. In our context, the organization a physician works in needs to be re-framed. Although many primary care physicians are established, they still are embedded in national healthcare systems. The construct needs to capture how these systems can support or inhibit the implementation of technologies within practices.

Table [27] provides short construct definitions and the expected correlations with behavioral use intentions.

| **Construct** | **Definition** | **Correlation** |
|---|---|---|
| Uncertainty | The degree of uncertainty underlying the decision to use the new technology. | Negative (-) |
| Transition costs | The amount of costs associated with implementing and using the new technology. | Negative (-) |
| Perceived value | The extent of value and benefit coming with the implementation and use of the new technology. | Positive (+) |
| Loss aversion | The degree to which the user seeks to avoid losses that might come with using the new technology. | Negative (-) |
| Anchoring effects | The degree to which the new technology has to withstand the expectations formed by the current way of working. | Negative (-) |
| Inertia | The tendency of the user to stick to current behavioral patterns and avoid changes. | Negative (-) |
| Sunk cost | The amount of efforts and resources the user has already put into the current way of working. | Negative (-) |
| Regret avoidance | The degree to which the user seeks to avoid decisions they might regret in the future. | Negative (-) |

| | | |
|---|---|---|
| Decisional control | The degree of freedom and autonomy the user has when deciding to choose, use, or reject the new technology. | Positive (+) |
| Organizational norms | The degree to which the organization (i.e., actors in the healthcare system) considers the new technology useful. | Positive (+) |
| Social norms | The degree to which social queues consider the new technology useful. | Positive (+) |
| Organizational support | The extent of support provided by the organization (i.e., actors in the healthcare system) in implementing and using the new technology. | Positive (+) |
| Colleague opinion | The degree to which colleagues consider the new technology useful. | Positive (+) |

**Table 27: Construct Definitions and Expected Correlations with Intention to Use**

We include several control variables within our model in order to check for possible alternatives to explain use intentions. Besides demographics, individuals' judgements might be influenced by past experiences related to technology use. Self-efficacy and computer self-efficacy might have further explanatory weight. Job responsibility, social desirability, and perceived (personal and job-related) threat represent additional controls. Polites and Karahanna (2012) suggest propensity to resist change, routine seeking, and personal innovativeness as controls. Figure [3] illustrates our resulting theoretical framework. We include 'Intention to use' as our dependent variable (DV), since it is an established measurement for the acceptance of technologies (Bhattacherjee and Hikmet 2007). Our framework suggests the examination of (1) direct effects the four SQBP dimensions have on the DV as well as (2) correlations within and between the dimensions. For instance, we expect organizational support to have an effect on transition costs, since first empirical insights suggest that higher degrees of external support reduce perceived efforts.

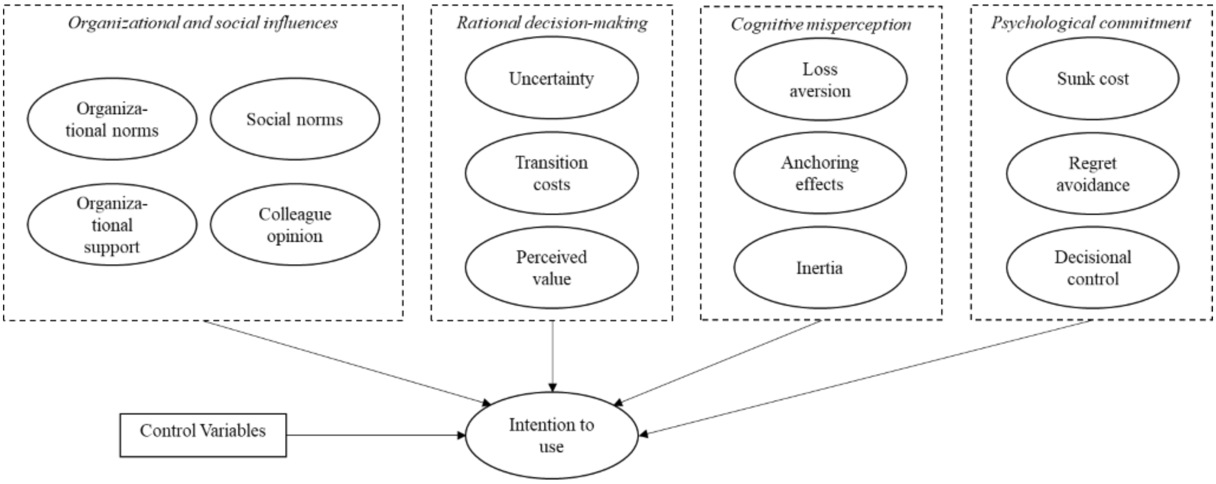


Figure 3: Theoretical Framework

## 13.4 Research Agenda and Preliminary Discussion

**Pre-study and Pilot.** As our pre-study, we conducted a focus group with primary care physicians (n=6, 54 years on average, all male) to elaborate a treatment scenario integrating health technologies into treatments and medical processes in the light of upcoming challenges (e.g., rural undersupply and scarce care access). As a result, the technological scenario that forms the foundation for empirical investigations consists of three incremental versions of a telemedical system for patient treatment whereby each version includes and supplements the features of the previous one: (1) Live video conferencing engaging spatially separated patient and physician, enabling face-to-face consultation and rudimental video-based examinations (e.g. wounds). (2) Patient-sided application of sensors that are able to measure vital parameters of importance to the physician (e.g. blood pressure). The captured data is transferred to the physician, enabling its immediate analysis. The physician can assess and potentially adjust the treatment and arrange a physical meeting if needed. (3) Ad-hoc data analysis, for instance in the form of an algorithm based on Artificial Intelligence that pre-analyses data before the result is shown to the physician. In that case, the physician will only be provided with relevant information drawn from raw data, for instance if certain vital parameters surpass a critical threshold. Next, we develop an initial questionnaire by adapting measurement items from literature to our context. To check for comprehensibility and meaningfulness of item and scenario wording, we conduct a pilot test with a small sample of primary care physicians (n=5). The final scenario will be used in both upcoming surveys. To account for potential effects the different versions of the setting might have on the way respondents answer our surveys, we include an additional control asking whether the whole scenario has been understood and is seen as meaningful and feasible. If not, the respondents are asked to indicate the system version (1, 2, or 3) that appeals to them most. In doing so, we are able to group our data set according to the indication and look for differences across our sample.

**First survey.** After revising the questionnaire, we conduct a large-scale survey in the form of an online questionnaire following a within-subject study design. Each participant will be provided with the same scenario described above. The survey link will be distributed to primary care physicians via a regional network consisting of primary care physicians and facilities as well as a state-wide healthcare network to ensure a sufficient amount of respondents (n=150 targeted). The goal of the first survey is to exploratively develop our theoretical model and check for significant correlations, using regression analysis and co-variance based path modelling. We further expect some of the constructs to not be highly selective when describing physicians' perceptions (e.g., perceived value and loss aversion). Hence, by performing an Explorative Factor Analysis, we seek to group related and (partially) overlapping constructs and form coherent predictors of technology acceptance. In doing so, we account for potential overlaps the different model dimensions and variables exhibit (e.g., loss aversion and regret avoidance). This potentially leads to a more condensed model and motivates future investigations of identified factors.

**Second survey.** Once we formed our final theoretical model, we conduct a second survey via an online questionnaire analogous to the first survey. To acquire a new sample that differs from the first one and avoid biases, we distribute the second survey link via a nationwide healthcare network to reach physicians across the country. We include a variety of items to measure our model as well as established acceptance models like TAM and UTAUT, enabling us to compare the explanatory power of each model, gaining insights on the suitability of SQBP as a theoretical basis and the potential need for an integrated model and further investigations. Since we aim for testing our model against established ones, we target a sample size of at least 500. For data analysis, we use regression analysis and co-variance based path modelling.

## 13.5 References

Bauchner, H. 2001. "Changing Physician Behaviour," Archives of Disease in Childhood (84:6), pp. 459–462.

Bhattacherjee, A., and Hikmet, N. 2007. "Physicians' Resistance toward Healthcare Information Technology: A Theoretical Model and Empirical Test," European Journal of Information Systems (16:6), pp. 725–737.

Boonstra, A., Versluis, A., and Vos, J. F. 2014. "Implementing Electronic Health Records in Hospitals: A Systematic Literature Review," BMC Health Services Research (14:1), p. 370.

Chau, P. Y. K., and Hu, P. J.-H. 2002. "Investigating Healthcare Professionals' Decisions to Accept Telemedicine Technology: An Empirical Test of Competing Theories," Information & Management (39:4), pp. 297–311.

Chaudhry, B., Wang, J., Wu, S., Maglione, M., Mojica, W., Roth, E., Morton, S. C., and Shekelle, P. G. 2006. "Systematic Review: Impact of Health Information Technology on Quality, Efficiency, and Costs of Medical Care," Annals of Internal Medicine (144:10), p. 742.

Chen, C. C., and Bode, R. K. 2011. "Factors Influencing Therapists' Decision-Making in the Acceptance of New Technology Devices in Stroke Rehabilitation:," American Journal of Physical Medicine & Rehabilitation (90:5), pp. 415–425.

Chismar, W. G., and Wiley-Patton, S. 2003. "Does the Extended Technology Acceptance Model Apply to Physicians," in Proceedings of the 36th Annual Hawaii International Conference on System Sciences, Big Island, USA: IEEE, 8 pp.

Crosby, L. A., and Taylor, J. R. 1983. "Psychological Commitment and Its Effects on Post-Decision Evaluation and Preference Stability among Voters," Journal of Consumer Research (9:4), pp. 413–431.

Cruess, R. L., and Cruess, S. R. 2008. "Expectations and Obligations: Professionalism and Medicine's Social Contract with Society," Perspectives in Biology and Medicine (51:4), pp. 579–598.

Demiris, G., and Hensel, B. K. 2008. "Technologies for an Aging Society: A Systematic Review of 'Smart Home' Applications," Yearbook of Medical Informatics (17:01), pp. 33–40.

El Halabieh, R., Beaudry, A., and Tamblyn, R. 2017. Impacts of Stress, Satisfaction and Behavioral Intention on Continued Usage: Evidence from Physicians Transitioning to a New Drug Management System, presented at the Proceedings of the 50th Hawaii International Conference on System Sciences.

Fleischmann, M., Amirpur, M., Benlian, A., and Hess, T. 2014. “Cognitive Biases in Information Systems Research: A Scientometric Analysis,” in Proceedings of the European Conference on Information Systems (ECIS) 2014, Tel Aviv, Israel, p. 23.

Gewald, H., and Gewald, C. 2017. “Physician’s Use of Mandatory Information Systems: An Exploratory Research in German Hospitals,” in Proceedings of the 50th Hawaii International Conference on System Sciences, Hawaii, USA, pp. 3411–3420.

Hsieh, P.-J., Lai, H.-M., and Ye, Y.-S. 2014. “Patients’ Acceptance and Resistance toward the Health Cloud: An Integration of Technology Acceptance and Status Quo Bias Perspectives,” in Proceeding of the 19th Pacific Asia Conference on Information Systems (PACIS 2014), Chengdu, China, p. 230.

Hu, T., Poston, R. S., and Kettinger, W. J. 2011. “Nonadopters of Online Social Network Services: Is It Easy to Have Fun Yet?,” Communications of the Association for Information Systems (29), pp. 441–458.

Huang, R.-T. 2015. “Overcoming Invisible Obstacles in Organizational Learning: The Moderating Effect of Employee Resistance to Change,” Journal of Organizational Change Management (28:3), pp. 356–368.

Kahneman, D. 2003. “Maps of Bounded Rationality: Psychology for Behavioral Economics,” The American Economic Review (93:5), pp. 1449–1475.

Kahneman, D., Knetsch, J. L., and Thaler, R. H. 1991. “Anomalies: The Endowment Effect, Loss Aversion, and Status Quo Bias,” Journal of Economic Perspectives (5:1), pp. 193–206.

Kahneman, D., and Tversky, A. 1979. “Prospect Theory: An Analysis of Decision under Risk,” Econometrica (47:2), pp. 263–292.

Kane, G. C., and Labianca, G. (Joe). 2011. “IS Avoidance in Health-Care Groups: A Multilevel Investigation,” Information Systems Research (22:3), pp. 504–522.

Karsh, B.-T., Holden, R. J., Alper, S. J., and Or, C. K. L. 2006. “A Human Factors Engineering Paradigm for Patient Safety: Designing to Support the Performance of the Healthcare Professional,” Quality and Safety in Health Care (15:suppl_1), pp. i59–i65.

Karsh, B.-T., Weinger, M. B., Abbott, P. A., and Wears, R. L. 2010. “Health Information Technology: Fallacies and Sober Realities,” Journal of the American Medical Informatics Association (17:6), pp. 617–623.

Kim, H.-W., and Kankanhalli, A. 2009. “Investigating User Resistance to Information Systems Implementation: A Status Quo Bias Perspective,” MIS Quarterly (33:3), p. 567.

Kohnke, A., Cole, M. L., and Bush, R. 2014. “Incorporating UTAUT Predictors for Understanding Home Care Patients’ and Clinician’s Acceptance of Healthcare Telemedicine Equipment,” Journal of Technology Management & Innovation (9:2), pp. 29–41.

Kvedar, J., Coye, M. J., and Everett, W. 2014. “Connected Health: A Review of Technologies and Strategies to Improve Patient Care with Telemedicine and Telehealth,” Health Affairs (33:2), pp. 194–199.

Lee, K., and Joshi, K. 2017. “Examining the Use of Status Quo Bias Perspective in IS Research: Need for Re-Conceptualizing and Incorporating Biases: Status Quo Bias Perspective in the IS Research,” Information Systems Journal (27:6), pp. 733–752.

Li, J., Liu, M., and Liu, X. 2016. “Why Do Employees Resist Knowledge Management Systems? An Empirical Study from the Status Quo Bias and Inertia Perspectives,” Computers in Human Behavior (65), pp. 189–200.

Lowenhaupt, M. 2004. “Removing Barriers to Technology.,” Physician Executive (30:2), pp. 12–14.

Martínez, A., Villarroel, V., Seoane, J., and Pozo, F. 2004. “Rural Telemedicine for Primary Healthcare in Developing Countries,” IEEE Technology and Society Magazine (23:2), pp. 13–22.

Pai, F.-Y., and Huang, K.-I. 2011. “Applying the Technology Acceptance Model to the Introduction of Healthcare Information Systems,” Technological Forecasting and Social Change (78:4), pp. 650–660.

Pantelopoulos, A., and Bourbakis, N. G. 2010. “A Survey on Wearable Sensor-Based Systems for Health Monitoring and Prognosis,” IEEE Transactions on Systems, Man, and Cybernetics (40:1), pp. 1–12.

Polites, G. L., and Karahanna, E. 2012. “Shackled to the Status Quo: The Inhibiting Effects of Incumbent System Habit, Switching Costs, and Inertia on New System Acceptance,” MIS Quarterly (36:1), pp. 21–42.

Pritchard, M. P., Havitz, M. E., and Howard, D. R. 1999. “Analyzing the Commitment-Loyalty Link in Service Contexts,” Journal of the Academy of Marketing Science (27:3), pp. 333–348.

Samhan, B. 2017. Patients’ Resistance towards Health Information Technology A Perspective of the Dual Factor Model of IT Usage, presented at the Proceedings of the 50th Hawaii International Conference on System Sciences, Hawaii, USA, pp. 3401–3410.

Samuelson, W., and Zeckhauser, R. 1988. “Status Quo Bias in Decision Making,” Journal of Risk and Uncertainty (1:1), pp. 7–59.

Simon, H. A. 1955. “A Behavioral Model of Rational Choice,” The Quarterly Journal of Economics (69:1), pp. 99–118.

Venkatesh, V., and Davis, F. D. 2000. “A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies,” Management Science (46:2), pp. 186–204.

Venkatesh, V., Morris, M. G., Davis, G. B., and Davis, F. D. 2003. “User Acceptance of Information Technology: Toward a Unified View,” MIS Quarterly (27:3), pp. 425–478.

Walter, Z., and Lopez, M. S. 2008. “Physician Acceptance of Information Technologies: Role of Perceived Threat to Professional Autonomy,” Decision Support Systems (46:1), pp. 206–215.

Wills, M. J., El-Gayar, O. F., and Bennett, D. 2008. “Examining Healthcare Professionals’ Acceptance of Electronic Medical Records Using UTAUT,” Issues in Information Systems (9:2), pp. 396–401.

Wilson, N., Couper, I., De Vries, E., Reid, S., Fish, T., and Marais, B. 2009. “Inequitable Distribution of Healthcare Professionals to Rural and Remote Areas,” Rural Remote Health (9:1060).

# 14 How Beating the Overconfidence Bias Can Prevent Medical Errors

| | |
|---|---|
| Title | **Demigods of Technology Use – How Beating the Overconfidence Bias Can Prevent Medical Errors** |
| Number | **P8** |
| Authors | Frederike Marie Oschinsky[1]<br>Marius Müller[1]<br>Björn Niehaves[1]<br><br>[1]University of Siegen<br>Kohlbettstraße 15<br>57072 Siegen |
| Publication Type | Conference Proceedings |
| Publication Outlet | Hawaii International Conference on System Sciences |
| Status | published |
| Full Citation | Oschinsky, F., Mueller, M., Niehaves, B. (2020), "Demigods of Technology Use – How Beating the Overconfidence Bias Can Prevent Medical Errors", 53rd Hawaii International Conference on System Sciences (HICSS 53), Hawaii, USA. |

**Table 28: Publication Overview (P8)**

# Demigods of Technology Use – How Beating the Overconfidence Bias Can Prevent Medical Errors

*Abstract*: The healthcare domain faces considerable challenges due to the digitization of medical processes and routines. Information technologies are designed to enable physicians to treat more patients and to increase service quality and patient safety. Despite acknowledging the rapid digital transformation of healthcare, research often neglects whether physicians are actually able to effectively decide which technology to use in which setting and whether their technology use thus effectively enhances quality and safety. Literature on cognitive biases already looked broadly at related errors in judgment and action and questioned rational behavior. Nevertheless, overconfidence, being one of the most common cognitive biases, has barely been linked to the accurate adoption and use of technology by physicians. Against this background, this research-in-progress paper proposes a framework for conducting a mixed-methods study based on the particularities of overconfidence in healthcare. We invite future research to compare our approach with established theoretical frameworks in IS research.

## 14.1 Introduction

Up to 40 percent of annual deaths in the United States are preventable [6]. Lethal errors happen in roughly 6 percent of hospital admissions [8, 9]. Literature shows that most preventable deaths are caused by social determinants [e.g., 35, 36]. However, no less important and representing an emphasis of this research-in-progress paper, many medical flaws and treatment inaccuracies occur due to cognitive biases, because physicians are susceptible to errors in judgment and decision-making [e.g., 11, 49]. When medical practitioners are selective about what they pay attention to, distorted thinking and cognitive biases occur. In the digital age, that also applies to their adoption and use of information technology (IT).

A cognitive bias is an error in thinking, which results from the attempt to simplify information processing. It is defined as a systematic deviation from rationality, whereby inferences are drawn in an illogical fashion [30, 45, 2, 3, 27]. Cognitive biases are the reason why individuals often come up with divergent or even ‘wrong’ conclusions when processing and interpreting information about the world around them [25]. Although many cognitive biases serve an adaptive purpose as they allow to make sense of the world rather quickly, they often outplay well-considered but time-consuming decisions.

Information Systems (IS) research acknowledged that human decision-making is one decisive area of interest in the IS domain [23]. This seems to be especially true for action-oriented biases such as overconfidence [16]. Pressing issues such as privacy, trust, and security, fuel academic interest in this respect. Because the body of psychological knowledge often facilitates to advance the discipline and to provide valuable recommendations for practitioners [16], our study seeks to continue progressing on that path. There is a huge opportunity for combining IS research with behavioral economics principles such as cognitive biases to shed light on technology use and to inform design science research. In particular, the growing area of NeuroIS demonstrates potential to bring explanatory power to cognitive effects [13].

Against this background, it is surprising that cognitive biases received only limited attention in the technology-related healthcare domain [16]. The massive amount of information available to physicians at the point they have to decide on whether or how to use a certain technology can lead to information overload, which can result in greater reliance on heuristics and greater susceptibility to biases. In fact, many studies already showed the influence of cognitive biases on erroneous decisions in other fields (e.g., aviation accidents [54]). Assessment tools have been applied to reduce shortcomings and to improve quality [e.g., 64]. Bearing in mind those related findings and guidelines, we focus on the healthcare domain due to its high vulnerability to human failure. Since physicians' errors can be fatal and costly [39, 32, 5, 34], we strive to understand and to improve decisions regarding whether or how to use a certain technology in that occupation.

We will focus on the occurrence of overconfidence, because it is considered one of the cornerstones that illustrate shortcomings in human information-processing capacities, thereby marking human irrationality. It is associated with diagnostic inaccuracies or suboptimal management [49] and correlates with an underestimation of risk factors and tolerance to ambiguity [45]. Thus, understanding the impact of overconfidence on a physician's decisions is a promising path illustrating how behavioral economics and IS research can travel together.

As literature leads to the assumption that overconfidence might be a crucial cause of medical errors, which occurs in the form of biased calibration, biased precision of numerical estimates, and biased placement of performance, we pose the following research questions (RQs):

**RQ1:** *How does overconfidence affect the accurate adoption and use of technology by physicians?*

**RQ2:** *How does overconfidence affect the medical errors made by physicians?*

Seeing the cognitive bias of overconfidence as an important area of interest when it comes to why and how physicians use technology, our work has four objectives: 1) to highlight the value to consider cognitive biases in the healthcare domain, 2) to show the benefits of linking technology adoption and use of physicians to overconfidence, 3) to present a research agenda on how to evaluate the influence of overconfidence on prevention, diagnosis, treatment, and rehabilitation, and 4) to guide future research. It is important to note that our paper thereby focuses on exceptions of daily medical practice, namely the times when cognitive processes fail while using technology, which implies that a medical action is missed or wrong. We expect that physicians have a high confidence in their technology use behavior, which leads to underappreciating the chance of medical errors due to inappropriate usage.

The overall goal is both to highlight the practical implications of our findings to derive valuable recommendation for medical practice. Moreover, our work strives for understanding the impact of overconfidence on medical technological decisions to offer a theoretical contribution to advance the field.

## 14.2 Theoretical background

In our outline, the physicians' technology adoption and use cover the whole band width of health technology and can easily be itemized into specific application scenarios (e.g., adoption and use of telemedicine or artificial intelligence software).

### 14.2.1 Cognitive biases in the healthcare domain

According to the paradigm of rational choice, people decide and act based on thorough cost-benefit analysis to maximize profits. The prerequisites for rational choices are that people 1) know exactly what they want and prioritize, 2) have a set of alternative courses of action, and 3) know the likelihood of the events which they include in their calculation of costs and benefits [62, 15]. It quickly becomes clear that this approach has a number of shortcomings and does not correspond properly to 'real' life. The most fundamental drawback is that no human knows everything, nor has s/he ideal mathematical methods. Homo sapiens, in contrast to Homo oeconomicus (aka Humans in contrast to Econs [57]), is unable to accurately identify all characteristics needed for an optimal decision. And even if s/he could: Calculating complex situations would take too long to make sense in an efficient manner. Knowledge deficits as well as restrictions in time and cognitive resources limit truly rational decision and action.

This leads to the concept of bounded rationality. According to the paradigm of rational choice, a sub-optimal calculation of costs and benefits is seen as irrational and obstructive for the realization of human goals [45]. However, the decision-theorist Herbert Simon (Nobel Prize 1978) was a pioneer to assume that choices are naturally bounded by a number of factors [e.g., 50, 51]. For instance, humans consider only few alternatives; usually only two (which he termed 'satisficing'). Moreover, they tend to value things they own more highly than the things they could achieve by changing action ('endowment effect'). In addition, they tend to continue previous behavior even at considerable costs ('status quo bias'). Having named just a few examples, it becomes clear that humans are happy with reasonably satisfactory solutions, even if there is a good chance that there is a much more favorable option [see for further insights 4, 60, 10, 21].

So how do humans actually decide? Are humans bounded in the sense that they can no longer effectively choose what to do? Gigerenzer and his colleagues negate this attitude and assume that the rational consideration of all relevant factors at hand often brings no advantage [22, 19]. In many situations, heuristic decision-making, based on a very narrow information base and following simple rules, is just as or almost as efficient as complex arithmetic operations – but much faster and cheaper. Heuristics focus on a few salient features that can be used to decide between alternatives. One of the most common heuristics is the awareness of past experiences (for instance due to 'framing' or 'anchoring'). Humans rate the popularity of things by how easily concerning information is retrievable from their memory ('availability' heuristic). Simple and fast procedures often prevail.

However, simplistic rules of thumb do not always bring benefits. Literature demonstrates severe cognitive limitations when it comes to complex decisions (e.g., decision-making in the healthcare domain). Human behavior in complex systems falls short in particular by: 1) starting without sufficient prior analysis of the situation, 2) disregarding the positive and negative influences of most factors and measures, 3) focusing on immediate events while ignoring long-term and side effects, 4) the rigid belief to have the right method, 5) fleeing into new projects when things are about to go wrong or 6) taking more and more radical measures when things get out of hand [14]. This lesson is highly relevant to the healthcare domain. In particular, the physicians' belief to have the 'right' method (i.e., 'overconfidence') seems untenable against the background of the prevalence of biases.

IS research acknowledged the relevance of human cognition and decision-making biases related to information systems [16, 23]. By providing a review of cognitive bias-related research in the IS discipline, Fleischmann et al. [16] revealed that the literature in this domain mainly concentrated on perception and decision biases (ibid.). They invited future research to be more diverse. Our work travels well with their idea to focus on action-oriented biases (e.g., 'overconfidence').

To sum up, many studies show the influence of cognitive biases on decision-making and provide valuable insights for the progress of our study. Although many cognitive biases serve an adaptive purpose as they allow to make sense of the world more quickly, they often outplay well-considered, but time-consuming, decisions. The fact that there are various sensitive issues where an elaborate analysis and decision-making is required [such as choosing whether or how to use a certain technology for diagnosis or treatment, see e.g., 20], is a fruitful start to study the accuracy of physicians' technology adoption and use.

### 14.2.2 Overconfidence in the healthcare domain

Based on a structured review by Saposnik and his colleagues [49], common cognitive biases associated with medical decisions are based on perception biases (such as 'framing' [e.g., 44, see also 7]) or stability biases (such as 'anchoring' [e.g., 52, see also 1]). Approaches considering action-oriented biases (such as 'overconfidence') were also considered (c.f. Table [29]). Action-orientated biases are a distinct subgroup within the category of decision biases [16]. Because premature decisions based on optimism without considering all relevant information are pressingly relevant for physicians as well, this paper seeks to further integrate action-oriented biases into the current debate.

Overconfidence is considered one of the cornerstones that illustrate shortcomings in human information-processing capacities, thereby marking human irrationality. It occurs in case our reliance related to judgments, inferences, or predictions is too high when compared to the corresponding accuracy [45]. Overconfidence is associated with diagnostic inaccuracies or suboptimal management [49] and leads to overestimation, over-precision, and over-placement [40]. Additionally, it correlates with an underestimation of risk factors and a high tolerance to ambiguity. Table [29] sums up general findings on overconfidence, which are relevant for our work.

| **Author (Year of Publication)** | **Title** | **Source** |
|---|---|---|
| Keren (1997) | “On the calibration of probability judgments: Some critical comments and alternative perspectives” | [31] |
| Klayman et al. (1999) | “Overconfidence: It depends on how, what, and whom you ask” | [33] |
| McGraw et al. (2004) | “The affective costs of overconfidence” | [37] |
| Moore and Healy (2008) | “The trouble with overconfidence” | [40] |
| Nandedkar and Midha (2009) | “Optimism in music piracy: A pilot study” | [42] |
| Rhee et al. (2005) | “I am fine but you are not: Optimistic bias and illusion of control on information security” | [47] |
| Tan et al. (2012) | “Consumer-based decision aid that explains which to buy: Decision confirmation or overconfidence bias?” | [55] |
| Van der Vyver (2004) | “The overconfidence effect and IT professionals” | [59] |
| Vetter et al. (2011) | “Overconfidence in IT investment decisions: Why knowledge can be a boon and bane at the same time” | [61] |

**Table 29: Preliminary Literature on Overconfidence**

The three most typical forms of overconfidence are “(1) calibration, (2) the precision of numerical estimates, and (3) people’s placement of their own performance relative to others” [45:291]. They point at the fact that the subjective confidence exceeds objective accuracy, the subjective confidence intervals are too narrow, and people tend to better-than-average estimations of their own contribution or skills relative to others. Subjective confidence is based on self-knowledge and helps make quick judgements, although objective quantities are unknown, unstructured or by other means rough [63]. Closely linked to overconfidence is the illusion of control as well as the stable individual trait of optimism [45].

Overconfidence is also of interest for IS research. The domain studied the bias's occurrence in many settings such as enterprise resource planning [e.g., 28], innovation management [e.g., 18], and performance [e.g., 41]. As technology use became ubiquitous in the healthcare domain, the number of studies concerning technology use for medical diagnoses and treatment began to rise. However, a comprehensive review of the available literature and current thinking related to these issues is missing in this discipline [16]. This hampers both theorizing and finding practical solution to improve the accuracy of medical decision making while using technology.

Evidence suggests that the incidence of overconfidence is likely to be greater among top executives (ibid.). Physicians are without question seen as such experts who are ambitious, competent and obstinate. The benefits of overconfidence can be threefold for them [45:91 ff.]: First, it might have a consumption value of feeling good. People naturally enjoy receiving positive feedback, praise, and approval (also from thinking well of themselves). Second, it might have a motivation value. People with high confidence set high goals and persist in the face of adversary. Third, it might be a valuable signal for convincing others. Optimism about future events can positively affect those developments. A physician being overconfident about a particular treatment can be considered as the cause of a self-fulfilling prophecy or placebo effect. Against this background, it is of crucial importance to consider overconfidence, when the 'demigods in white' decide on whether or how to use a certain technology. Table [30] sums up recent findings on clinicians' overconfidence [see 49], also taking into account literature regarding the effect of overconfidence on medical errors.

| **Author (Year of Publication)** | **Title** | **Source** |
|---|---|---|
| Friedman et al. (2005) | "Are clinicians correct when they believe they are correct? Implications for medical decision support" | [17] |
| Meyer et al. (2013) | "Physicians' diagnostic accuracy, confidence, and resource requests: a vignette study" | [38] |

| | | |
|---|---|---|
| Crowley et al. (2013) | “Automated detection of heuristics and biases among pathologists in a computer-based system” | [12] |
| Saposnik et al. (2013) | “Accuracy of clinician vs risk score prediction of ischemic stroke outcomes” | [48] |
| Stiegler et al. (2012) | “Decision-making and safety in anaesthesiology” | [53] |
| Ogdie et al. (2012) | “Seen through their eyes: residents’ reflections on the cognitive and contextual components of diagnostic errors in medicine” | [43] |
| Saposnik, et al. (2016) | “Cognitive biases associated with medical decisions: A systematic review” | [49] |

**Table 30: Preliminary Literature and Current Findings on Clinicians’ Overconfidence**

### 14.3 Model development

Based on the theoretical background, we developed a preliminary research model. Overconfidence is considered as the independent variable. On the one hand, we propose a relation between overconfidence and technology use and seek to answer RQ1. On the other hand, we want to find out how overconfidence affects medical errors made by physicians to answer RQ2. We integrate technology use as a moderating variable that affects the strength of the relationship between medical errors and overconfidence. It is expected to have an amplifying effect. We will test for the moderating relation in an analysis of variance, where it is represented by the interaction effect between the dependent variable and the factor variable.

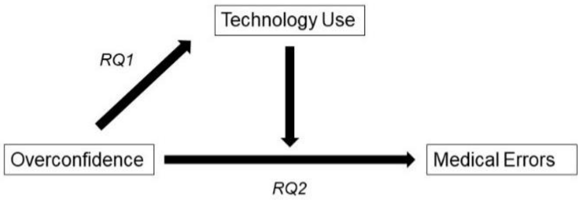


**Figure 4: Model Development**

### 14.4 Research design and data analysis

Studying a complex decision in the healthcare domain offers tremendous potential. Because behavioral economic researchers rely mostly on experiments, it is a great opportunity to test their findings against other data [23]. As IS researchers have quite some knowledge in collecting and assembling observational datasets of technology adoption and use, these datasets provide a valuable source to fulfil this goal – also pointing at the potential of field experiments (e.g., in IT-mediated environments) to provide a middle ground between laboratories and observational data (ibid.). However, since there is no potential existing dataset to utilize, we propose a two-step mixed-methods approach to answer our RQs.

As noted above, physicians increasingly have many healthcare technologies at hand to decide whether or which one to use. Although there may be just one integrated healthcare information system for a hospital, especially resident physicians may have the luxury of multiple healthcare technologies. These can be various software, different possibilities for video consultation, sensor technology in medical devices or an integration of artificial intelligence (e.g., in the anamnesis of new patients). The multitude of technologies as well as their possible modes of operation is constantly increasing. Therefore, we do not want to commit to a specific technology in this work yet. However, the selection of a specific technology and a concrete application scenario is to be worked out in the proposed study directly at the beginning.

In a first step, we hand out a short survey to a group of physicians. We thereby want to answer RQ1 (How does overconfidence affect the accurate adoption and use of technology by physicians?). Table [31] provides initial questions regarding the proposed survey. Please note that actual objective answers are not available, but also not necessary, as the subjective answers illustrate a specific percentile of the entire reference population (e.g., top half) which makes the comparison of the percentage of people who believe they are in this percentile with the percentile itself meaningful.

| **Concept** | **Selection of questions** |
|---|---|
| Tolerance to technology-related uncertainty [46] | It is fine for me that…<br>…there are always new developments in the technologies we use.<br>…there are constant changes in computer software.<br>…there are constant changes in computer hardware. |

| | |
|---|---|
| Aversion to risk [24] | I am a cautious person who generally avoids risk.<br>I am very willing to take risks when choosing a job or project to work on.<br>I usually play it safe, even if it means occasionally losing out on a good opportunity. |
| Confidence in the appropriateness of technology adoption and use [adapted from 45] | How high do you rate the correctness of a patient's medical history created by artificial intelligence software?<br>How likely is it that you integrate this information into your daily work routine? |
| Confidence around numerical estimates of technology use [adapted from 45] | In which year will the first fully electronic surgery take place? |
| Placement on rankings [adapted from 45] | To what extent are you taking advantage of telemedicine opportunities compared to your fellow colleagues?<br>Do you think you finished your final exam in the top half of your class? |

**Table 31: Sample Questions for the later Survey**

The survey will be piloted with 50 respondents. Its items are adapted from the ones provided by Pohl [45]. Since our institute has a large network of doctors (outpatient and inpatient), we then aim to distribute the survey to at least 200 physicians of all disciplines. The specific discipline and the place of work (outpatient or inpatient) are controlled. First, we want to identify critical personality traits (e.g., tolerance to uncertainty, aversion to risk and ambiguity) and demographics. Second, we present questions pointing at overconfidence but disguise them as questions about general education and attitude (e.g., 'Do you think you finished your final exam in the top half of your class?'). Great exemplary questions are presented by Pohl and the collected authorship of his omnibus [45]. Because of the concealment, we will seek an ethical motion given by the University's ethics committee. Successively, we will inquire 1) the mean confidence in the appropriateness of technology adoption and use (e.g., (I) ‘How high do you rate the correctness of a patient’s medical history created by artificial intelligence software? (II) How likely is it that you integrate this information into your daily work routine?’ (both questions rated on a Likert scale from 1-7)), 2) the subjective confidence around numerical estimates of technology adoption and use (e.g., ‘In which year will the first fully electronic surgery take place?’), 3) the mean subjective placement on rankings (e.g., ‘To what extent are you taking advantage of telemedicine opportunities compared to your fellow colleagues?’ (on a Likert scale from 1-7)). These findings provide us a picture of the overall overconfidence among physicians as we expect that the physicians’ confidence on whether and how to use a certain technology exceeds objective accuracy, that their subjective confidence intervals are oftentimes too narrow, and that they tend to better-than-average estimations of their own contribution or skills relative to others.

In a second step, we chose a qualitative research design as we seek to understand and interpret events from the perspective of the physicians involved. We thereby want to answer RQ2 (How does overconfidence affect the medical errors made by physicians?). First, we present a short film (3 min) about a typical treatment situation to each participant in which no medical mistakes are made. An interviewer discusses the presented situation in a semi-structured manner and asks (subsequently implicitly and explicitly) about the occurrence of cognitive biases (e.g., overconfidence and illusion of control). Second, we present a short film (3 min) to the same person about an atypical treatment situation in which a medical mistake is made. Again, the interviewer discusses the presented situation and asks (subsequently implicitly and explicitly) about the occurrence of cognitive biases (e.g., overconfidence and illusion of control). Then, the physicians are thanked and debriefed. The interviews are seen as beneficial to understand how overconfidence can impact medical errors, focusing on the individual cognitive processes of each particular physician. We identified a selection of exemplary questions concerning our proposed scenarios (c.f. Table [32]).

| **Concept** | **Selection of questions** |
|---|---|
| Overconfidence [among others adapted from 38] | How would you rate the likelihood of committing a medical error in this situation?<br>How much would you rely on the presented technology when treating this patient?<br>How would you rate the amount of risk factors?<br>Do you feel that this situation is ambiguous? |
| Optimism [adapted from 26] | In this situation, …<br>…the use of technology is enhancing our standard of treatment.<br>…treatment will be easier and faster with technology.<br>…technology is a fast and efficient means of getting information.<br>…technology can eliminate a lot of tedious work. |
| Illusion of control [adapted from 29] | How would you rate the amount of control you have over this work situation?<br>How would you rate the amount of control you have over your contribution to the well-being of this patient? |

**Table 32: Sample Questions for the later Interview Guide**

The quantitative part of the study is analyzed using empirical social research methods. On the one hand, a confirmatory factor analysis is conducted to check whether the three expected subcategories of overconfidence (i.e. calibration, precision of numerical estimates, placement of performance) are reflected in the data. The relationships are further studied by executing univariate and multivariate regression analysis. Next, the qualitative part of the study will be audibly recorded and transcribed. The analysis consists of the identification of analysis units and the definition and coding of structured dimensions. The transcripts are interpreted independently by two researchers and finally checked for intercoder reliability. The analysis phase closes with a quantitative evaluation, a final interpretation, and a derivation of recommendations for actions from the analysis units.

Figure [5] shows the proposed research agenda, the related RQ for each step and the sample as well as sample size. The first sample covers the physicians in the pilot test. The second sample encompasses the physicians in the actual survey.

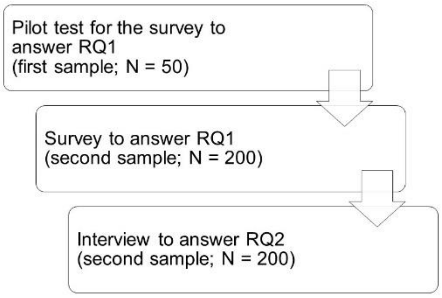


**Figure 5: Research Agenda**

We keep in mind that overconfidence might depend on the sampling procedure and how performance is assessed [45]. Besides, the sampling procedure can be confounded with item difficulty and overconfidence can co-vary with item difficulty. Besides these potential limitations, the advantage of our mixed-method study is that it provides a complete picture of the particularities of overconfidence and assumptions about the underlying mechanisms of technology adoption and use. The design is well suited to explain the physicians' reality. It takes advantage of both methodological approaches and minimizes associated pitfalls. As a result, the qualitative results can be statistically generalized and the relevance and replicability of the quantitative findings can be increased.

### 14.5 Concluding remarks on how to beat cognitive biases by design

Against the background that the healthcare domain faces major changes and challenges, questions arise on whether physicians are able to effectively decide which technologies to use in which setting and whether their technology use subsequently enhances treatment quality and thus patient safety. Literature on cognitive biases broadly looked at errors in judgment and decision-making, while questioning rational behavior. However, overconfidence, being one of the most common cognitive biases, has barely been linked to the accurate adoption and use of technology by physicians. We proposed a mixed-methods study based on the particularities of overconfidence. The study's main aims are to provide new insights that may affect patient outcomes (e.g., avoidable hospitalizations, complications related to a procedure, prevention of unnecessary tests or medication, etc.) and to help attenuate medical errors. To stress the importance of these aims, we briefly address the implications of our work.

*Theoretical implications.* In order to provide a holistic view on the IS domain, we invite future research to further compare our findings with established theoretical frameworks in IS research (e.g., theory of planned behavior). This can also mean adding further variables to the model (e.g., perceived ease of use, perceived usefulness). Since most literature about technology adoption and use is based on the rational choice paradigm, our investigation has the potential to question and test human decision-making and judgement. In addition, there is a chance that IS research and behavioral economics research travel together and learn from one another. Moreover, a theoretical direction is that the effects of biases can be manipulated by nudging humans in directions that will make their lives better and easier [58]. Thus, the nudge paradigm is seen as very promising in the healthcare domain, too, and opens the door for further question on the physicians' technology adoption and use. Digital health solutions that incorporate nudges [e.g., interactive text-message reminders or haptic medication alerts, see 56] might create innovative pathways and can be studied as use cases.

*Implications for practice and design.* As an outcome of our research, it can be discussed how technology can be designed to reduce overconfidence of physicians. Thus, future research can promote direct insights into how to design technologies for everyday medical practice to reduce medical errors. Future quantitative studies can objectify and embed these results. On top of that, future work is invited to review existing tools to reduce the occurrence of cognitive biases (e.g., checklists, cognitive calibration) to provide further recommendation on how to reduce overconfidence. When it comes to training and education for physicians, one can also think of new digital technologies such as augmented reality and virtual reality, which have a demonstrably positive effect on learning success. Since effective educational strategies are needed to overcome the effect of cognitive biases on medical judgement and decision-making when adapting and using technology, prospective studies evaluating and comparing different training strategies are highly valuable.

## 14.6 References

[1] Allen, G., and J. Parsons, “Is Query Reuse Potentially Harmful? Anchoring and Adjustment in Adapting Existing Database Queries”, Information Systems Research 21(1), 2010, pp. 56–77.

[2] Ariely, D., Predictably Irrational: The Hidden Forces that Shape our Decisions, Harper, New York, NY, 2008.

[3] Baron, J., Thinking and Deciding, Cambridge University Press, New York, 2008.

[4] Becker, G.S., “Irrational Behavior and Economic Theory”, Journal of Political Economy 70(1), 1962, pp. 1–13.

[5] van den Berge, K., and S. Mamede, “Cognitive Diagnostic Error in Internal Medicine”, European Journal of Internal Medicine 24(6), 2013, pp. 525–529.

[6] Centers for Disease Control and Prevention, “Up to 40 Percent of Annual Deaths from Each of Five Leading US Causes are Preventable”, Premature deaths from each cause due to modifiable risks, 2014. https://www.cdc.gov/media/releases/2014/p0501-preventable-deaths.html

[7] Cheng, F.-F., and C.-S. Wu, “Debiasing the Framing Effect: The Effect of Warning and Involvement”, Decis. Support Syst. 49(3), 2010, pp. 328–334.

[8] Classen, D.C., S.L. Pestotnik, R.S. Evans, and J.P. Burke, “Computerized Surveillance of Adverse Drug Events in Hospital Patients”, JAMA 266(20), 1991, pp. 2847–2851.

[9] Committee on Quality of Health Care in America, Crossing the Quality Chasm: A New Health System for the 21st Century, National Academies Press, Institute of Medicine, Washington D.C., 2001.

[10] Cook, K.S., and M. Levi, The Limits of Rationality, University of Chicago Press, 2008.

[11] Croskerry, P., “The Importance of Cognitive Errors in Diagnosis and Strategies to Minimize Them”, Academic Medicine 78(8), 2003, pp. 775.

[12] Crowley, R.S., E. Legowski, O. Medvedeva, et al., “Automated Detection of Heuristics and Biases among Pathologists in a Computer-based System”, Advances in Health Sciences Education: Theory and Practice 18(3), 2013, pp. 343–363.

[13] Dimoka, A., F.D. Davis, A. Gupta, et al., “On the Use of Neurophysiological Tools in IS Research: Developing a Research Agenda forNeuroIS”, MIS Quarterly 36(3), 2012, pp. 679–702.

[14] Dörner, D., Die Logik des Misslingens: Strategisches Denken in komplexen Situationen, Rowohlt Verlag GmbH, 2011.

[15] Esser, H., Soziologie. Spezielle Grundlagen. Band 1: Situationslogik und Handeln, Campus Verlag, Frankfurt/Main, 2002.

[16] Fleischmann, M., M. Amirpur, A. Benlian, and T. Hess, “Cognitive biases in information systems research: A scientometric analysis”, Proceedings of the European Conference on Information Systems (ECIS), (2014).

[17] Friedman, C., G. Gatti, A. Elstein, T. Franz, G. Murphy, and F. Wolf, “Are clinicians correct when they believe they are correct? Implications for medical decision support”, Studies in health technology and informatics(1), 2001, pp. 454–458.

[18] Galasso, A., and T.S. Simcoe, “CEO Overconfidence and Innovation”, Management Science 57(8), 2011, pp. 1469–1484.

[19] Gigerenzer, G., Adaptive Thinking: Rationality in the Real World, Oxford University Press, Oxford, 2002.

[20] Gigerenzer, G., Das Einmaleins der Skepsis: Über den richtigen Umgang mit Zahlen und Risiken, eBook Berlin Verlag, Berlin, 2014.

[21] Gigerenzer, G., and R. Selten, Bounded Rationality: The Adaptive Toolbox, MIT Press, Cambridge, 2002.

[22] Gigerenzer, G., P.M. Todd, and A.R. Group, Simple Heuristics that Make Us Smart, Oxford University Press, Oxford, 2000.

[23] Goes, P.B., “Editor’s Comments: Information Systems Research and Behavioral Economics”, MIS Q. 37(3), 2013, pp. iii–viii.

[24] Gray, P.H., and A. Durcikova, “The Role of Knowledge Repositories in Technical Support Environments: Speed Versus Learning in User Performance”, Journal of management Information Systems 22(3), 2005, pp. 159–190.

[25] Greifeneder, R., H. Bless, and K. Fiedler, Social Cognition: How Individuals Construct Social Reality, Psychology Press, London, 2017.

[26] Harrison, A.W., and R.K. Rainer, “The Influence of Individual Differences on Skill in End-User Computing”, Journal of management Information Systems 9(1), 1992, pp. 93–111.

[27] Haselton, M.G., D. Nettle, and D.R. Murray, “The Evolution of Cognitive Bias”, In Handbook of Evolutionary Psychology. John Wiley & Sons, Hoboken, NJ, USA, 2016, 968–987.

[28] Hunton, J.E., A.M. Wright, and S. Wright, “Are Financial Auditors Overconfident in Their Ability to Assess Risks Associated with Enterprise Resource Planning Systems?”, Journal of Information Systems, 2004, pp. 22.

[29] Johnson, W., and R.F. Krueger, “How Money Buys Happiness: Genetic and Environmental Processes Linking Finances and Life Satisfaction”, Journal of Personality and Social Psychology 90(4), 2006, pp. 680–691.

[30] Kahneman, D., and A. Tversky, “Subjective Probability: A Judgment of Representativeness”, Cognitive Psychology 3(3), 1972, pp. 430–454.

[31] Keren, G., “On The Calibration of Probability Judgments: Some Critical Comments and Alternative Perspectives”, Journal of Behavioral Decision Making 10(3), 1997, pp. 269–278.

[32] Khoo, E.M., W.K. Lee, S. Sararaks, et al., “Medical Errors in Primary Care Clinics: A Cross Sectional Study”, BMC family practice 13, 2012, pp. 127.

[33] Klayman, J., J.B. Soll, C. González-Vallejo, and S. Barlas, “Overconfidence: It Depends on How, What, and Whom You Ask”, Organizational Behavior and Human Decision Processes 79(3), 1999, pp. 216–247.

[34] Mamede, S., T. van Gog, K. van den Berge, J.L.C.M. van Saase, and H.G. Schmidt, “Why do Doctors Make Mistakes? A Study of the Role of Salient Distracting Clinical Features”, Academic Medicine: Journal of the Association of American Medical Colleges 89(1), 2014, pp. 114–120.

[35] Marmot, M., “Social Determinants of Health Inequalities”, Lancet Public Health 365, 2005, pp. 1099–1104.

[36] Marmot, M., J. Allen, R. Bell, E. Bloomer, and P. Goldblatt, “WHO European Review of Social Determinants of Health and the Health Divide”, The Lancet 380, 2012, pp. 1011–1029.

[37] McGraw, A.P., B.A. Mellers, and I. Ritov, “The affective costs of overconfidence”, Journal of Behavioral Decision Making 17(4), 2004, pp. 281–295.

[38] Meyer, A.N., V.L. Payne, D.W. Meeks, R. Rao, and H. Singh, “Physicians’ diagnostic accuracy, confidence, and resource requests: a vignette study”, JAMA internal medicine 173(21), 2013, pp. 1952–1958.

[39] Michaels, A.D., S.A. Spinler, B. Leeper, et al., “Medication Errors in Acute Cardiovascular and Stroke Patients: A Scientific Statement from the American Heart Association”, Circulation 121(14), 2010, pp. 1664–1682.

[40] Moore, D.A., and P.J. Healy, “The trouble with overconfidence.”, Psychological Review 115(2), 2008, pp. 502–517.

[41] Moores, T.T., and J.C.-J. Chang, “Self-efficacy, overconfidence, and the negative effect on subsequent performance: A field study”, Information & Management 46(2), 2009, pp. 69–76.

[42] Nandedkar, A., and V. Midha, “Optimism in Music Piracy: A Pilot Study”, Proceedings of the Thirtieth International Conference on Information Systems, (2009).

[43] Ogdie, A.R., J.B. Reilly, M.W.G. Pang, et al., “Seen through their eyes: residents’ reflections on the cognitive and contextual components of diagnostic errors in medicine”, Academic medicine: journal of the Association of American Medical Colleges 87(10), 2012, pp. 1361.

[44] Perneger, T.V., and T. Agoritsas, “Doctors and patients’ susceptibility to framing bias: a randomized trial”, Journal of General Internal Medicine 26(12), 2011, pp. 1411–1417.

[45] Pohl, R.F., Cognitive Illusions: A Handbook on Fallacies and Biases in Thinking, Judgement and Memory, Psychology Press, London, 2004.

[46] Ragu-Nathan, T.S., M. Tarafdar, B.S. Ragu-Nathan, and Q. Tu, “The consequences of technostress for end users in organizations: Conceptual development and empirical validation”, Information Systems Research 19(4), 2008, pp. 417–433.

[47] Rhee, H.-S., Y. Ryu, and C.-T. Kim, “I Am Fine but You Are Not: Optimistic Bias and Illusion of Control on Information Security”, Proceedings of the Twenty-Sixth International Conference on Information Systems, (2005).

[48] Saposnik, G., R. Cote, M. Mamdani, et al., “JURaSSiC: accuracy of clinician vs risk score prediction of ischemic stroke outcomes”, Neurology 81(5), 2013, pp. 448–455.

[49] Saposnik, G., D. Redelmeier, C.C. Ruff, and P.N. Tobler, “Cognitive Biases Associated with Medical Decisions: a Systematic Review”, BMC Medical Informatics and Decision Making 16(1), 2016.

[50] Simon, H.A., “Rational Decision Making in Business Organizations”, The American Economic Review 69(4), 1979, pp. 493–513.

[51] Simon, H.A., “Bounded Rationality”, In J. Eatwell, M. Milgate and P. Newman, eds., Utility and Probability. Palgrave Macmillan UK, London, 1990, 15–18.

[52] Sorum, P.C., J. Shim, G. Chasseigne, S. Bonnin-Scaon, J. Cogneau, and E. Mullet, “Why do primary care physicians in the United States and France order prostate-specific antigen tests for asymptomatic patients?”, Medical Decision Making: An International Journal of the Society for Medical Decision Making 23(4), 2003, pp. 301–313.

[53] Stiegler, M.P., and K.J. Ruskin, “Decision-making and Safety in Anesthesiology”, Current Opinion in Anaesthesiology 25(6), 2012, pp. 724–729.

[54] Stripe, S.C., L.G. Best, S. Cole-Harding, B. Fifield, and F. Talebdoost, "Aviation Model Cognitive Risk Factors Applied to Medical Malpractice Cases", Journal of the American Board of Family Medicine: JABFM 19(6), 2006, pp. 627–632.

[55] Tan, W.-K., C.-H. Tan, and H.-H. Teo, "Consumer-based decision aid that explains which to buy: Decision confirmation or overconfidence bias?", Decision Support Systems 53(1), 2012, pp. 127–141.

[56] Textra Healthcare, LLC., "Textra Healthcare", TextConnect: Connecting Patients and Providers, 2019. http://textrahealthcare.com/

[57] Thaler, R.H., Misbehaving: The Making of Behavioural Economics, W W Norton & Co., New York, 2015.

[58] Thaler, R.H., and C.R. Sunstein, Nudge: Improving Decisions About Health, Wealth and Happiness, Penguin, London, 2009.

[59] Van der Vyver, G., "The Overconfidence Effect and IT Professionals", Proceedings of the European Conference on Information Systems (ECIS), (2004).

[60] Vanberg, V.J., "The rationality postulate in economics: its ambiguity, its deficiency and its evolutionary alternative", Journal of Economic Methodology 11(1), 2004, pp. 1–29.

[61] Vetter, J., A. Benlian, and T. Hess, "Overconfidence in IT Investment Decisions: Why Knowledge can be a Boon and Bane at the same Time", Proceedings of Thirty-Second International Conference on Information Systems, (2011), 17.

[62] Weber, M., Gesammelte Aufsätze zur Wissenschaftslehre, J.C.B. Mohr, Tübingen, 1922.

[63] Winman, A., P. Hansson, and P. Juslin, "Subjective Probability Intervals: How to Reduce Overconfidence by Interval Evaluation", Journal of Experimental Psychology: Learning, Memory, and Cognition 30(6), 2004, pp. 1167–1175.

[64] Zeltser, M.V., and D.B. Nash, "Approaching the Evidence Basis for Aviation-derived Teamwork Training in Medicine", American Journal of Medical Quality: The Official Journal of the American College of Medical Quality 25(1), 2010, pp. 13–23.

# 15 Digitally Influenced Relationship between Patients and Physicians

| | |
|---|---|
| Title | **Constituting Factors of a Digitally Influenced Relationship between Patients and Primary Care Physicians in Rural Areas** |
| Number | **P9** |
| Authors | Marius Müller[1]<br>Michael Knop[1]<br>Caroline Reßing[1]<br>Henrik Freude[1]<br>Frederike Marie Oschinsky[1]<br>Hans Christian Klein[1]<br>Björn Niehaves[1]<br><br>[1]University of Siegen<br>Kohlbettstraße 15<br>57072 Siegen |
| Publication Type | Conference Proceedings |
| Publication Outlet | Hawaii International Conference on System Sciences |
| Status | published |
| Full Citation | Mueller, M., Knop, M., Reßing, C., Freude, H., Oschinsky, F., Klein, H., Niehaves, B. (2020), "Constituting Factors of a Digitally Influenced Relationship between Patients and Primary Care Physicians in Rural Areas", 53rd Hawaii International Conference on System Sciences (HICSS 53), Hawaii, USA. |

**Table 33: Publication Overview (P9)**

# Constituting Factors of a Digitally Influenced Relationship between Patients and Primary Care Physicians in Rural Areas

*Abstract*: In times of an ageing society and a rural exodus of primary care physicians, healthcare systems are facing major challenges. To maintain comprehensive care and an equitable access to healthcare services, today's technological advancements represent a promising measure. Technologies empower patients by providing innovative tools such as sensors and applications for self-measurement, leading to self-initiated interventions, while supporting physicians in handling rising demands through telemedicine and spatially detached solutions. These enhanced treatments come with patient and physician-sided challenges such as incorrect digital information provided to the patient, negatively affecting treatment quality and leading to high issue resolving efforts. In order to investigate the perspectives of rural physicians on treatment digitalization and effects of patient empowerment, we conducted a qualitative study using semi-structured interviews. Our findings show that patient activation, impacts on treatment process, patient differentiation, and patient-physician-interaction are relevant factors in the physicians' valuation and willingness to use health technologies.

## 15.1 Introduction

In times where digitalization and innovative tools have an impact on multiple areas of life, technological advancements promise benefits for therapeutic treatment processes and healthcare in general. The possibility to overcome long distances, while technical limitations are declining due to structural expansions and governmental investments, enable an unprecedented and timely alternative to common care structures and processes. Today's healthcare systems exhibit shortcomings that threaten the maintenance and stable provision of comprehensive care. In many countries and rural regions in particular, the endemic healthcare system is hardly suited to adequately face ongoing demographic changes and the rising numbers of age-related health issues [9]. Increasing patient numbers lead to a demand surpassing the current healthcare supply, which is reinforced by medical professionals and graduates moving to urban and often more attractive regions. The resulting rural undersupply leads to a spatially as well as temporally limited access to care and an inequitable distribution of care facilities [36]. This development increasingly pressures practicing physicians and professionals.

Technologies potentially provide alternatives to analogous, location-based, and often unilateral care [20]. For instance, modern communication tools such as live video conferencing enable geographically detached physician consultations [18]. Body-worn sensory equipment, ranging from medical products developed for health and treatment purposes to consumer technologies such as smartwatches [27], further enable mutual therapeutic processes in which patients take more active roles by measuring their personal vital signs [23], informing themselves about health issues and treatments [1], and showing increasing degrees of overall health literacy [17]. Both examples show how to overcome mobility issues caused by illness or infrastructural shortages.

Since digital innovations empower patients and physicians in either managing their condition or performing treatments and work processes in the face of high demand, new questions and challenges arise. On the consumer side, patients are confronted with a plethora of available technologies and health-related information offered by the internet and mHealth applications. Difficulties arise when a user needs to judge on what technologies to use and how, which represents a major factor in ageing societies [14]. Furthermore, while potentially delivering benefits for effective self-management and behavior in case of health issues, the assessment of information and data can lead to misinterpretation, misguidance, or excessive demand, while information quality and correctness is oftentimes questionable [29]. On the provider side, physicians and medical staff are obliged to incorporate technological solutions into their work routines, supplementing or even altering their way of working. They need to acquire competences to implement digital processes and to use the provided devices in an efficient and appropriate way [6], while guidance and financial support is oftentimes scarce [31]. In addition, physicians have to deal with issues arising from patient-sided activities and empowerment. Problems originating in misusing, misinterpreting, or relying on flawed information lead to an increased workload to resolve these issues and safeguard treatment quality and patient health [1].

Consequently, bringing together challenges in rural areas and the perceptions of physicians regarding the application of health technologies for patient treatment as two major factors influencing successful IT implementation and adoption, the physician perspective needs to be illuminated in more detail. To date, research on how physicians in rural areas perceive, anticipate, and evaluate treatment digitalization and accompanying patient empowerment under the light of emerging challenges is scarce. We conducted an explorative, qualitative study in the form of seven semi-structured interviews to investigate and fill this gap. Thus, our paper contributes to our understanding of the potential impacts, benefits, and issues that arise from digital interventions in rural areas, enabling the design of needs-based and acceptable solutions in times where IT adoption rates in healthcare are low [16]. To gather perspectives rural physicians have on applying technologies in patient treatment, the interview guideline used in our study covers questions on (1) the interviewees' general perceptions regarding rural healthcare, digitalization, job and patient related factors, and (2) assessments of a concrete technical setting. This setting describes a video-conferencing tool that can be used for patient-physician communication, supplemented by sensors that capture data and transfer them to the physician. We see our paper as an initial step of investigation where we focus on the physician side in particular. Perspectives of the patients, thus, remain a future research topic enabling comparative studies and insights. The study at hand is guided by the following research question (RQ):

**RQ:** *What factors constitute the perspectives of physicians on the utilization of patient-empowering digital technologies in rural areas?*

### 15.2 Theoretical Background

As a theoretical baseline for our study, we look at related work concerning patient empowering effects of healthcare and treatment digitalization as well as specifics of rural areas that affect the applicability, necessity, and evaluation of digital interventions.

#### 15.2.1 Digital Patient Empowerment

Whereas traditional treatment settings commonly involve bilateral relationships between patients and physicians based on interpersonal factors [13], the introduction of digital technologies into therapeutic processes creates trilateral scenarios by introducing health technologies as a third actor in the treatment process [34]. Besides the physician and the patient, technologies can take active (e.g., by actively informing the user when certain parameters surpass thresholds) and/or passive roles (e.g., by solely reacting to user queries such as health information retrieval) supplementing treatments by, for instance, measuring health data [22, 35], delivering information [19], or enabling communication [18].

Health technologies and digitized treatment support enable a deliberation of healthcare service provision as well as treatment execution and adjustment, empowering patients to take more care of themselves and increase their levels of health efficacy. As a result, "[a]dvances in technology have empowered patients to be informed, which enabled them to play an active role in clinical encounters with the doctor" (p. 1) [26]. As an essential characteristic of the deliberative physician-patient relationship model, Emanuel and Emanuel [10] describe, that "[…] the aim of the physician-patient interaction is to help the patient determine and choose the best health-related values that can be realized in the clinical situation" (p. 2222). The model stipulates that the physician should suggest which health-related values should be pursued and, based on that, figure out the best and most desired way of treatment in cooperation with the patient. Physicians and patients step into a co-creation of therapeutic treatment [26].

Looking at current advancements in digitally supplemented healthcare such as the technology-enabled self-measurement of vital parameters (e.g., via smartwatch) or looking up and discussing health-related information online, deliberation takes place in a new form. Values with regard to diseases, appropriate therapeutic measures, and desired outcomes can be increasingly generated and assessed by the empowered patient [34]. Through activities like information seeking and accessing health-related information via the internet or peers, patients oftentimes form expectations and preconceptions on (a) their condition and (b) what treatment allegedly suits them best before even consulting a physician or therapist [34]. As a result, patient empowerment leads to an increase in patient-sided sense of mastery and control as well as self-efficacy and potentially improved decision-making [5]. This development has several implications for both healthcare providers and consumers. While digital tools have the potential to improve and, in case of rural undersupply and scarce access to care, enable treatments without temporal and spatial bounds, technologies can have negative impacts as well. Misunderstandings and potentially harmful actions patients may take based on flawed information [29] have to be counteracted by physicians and technology providers as well [1]. Consequently, the examination of patient and physician perspectives on treatment digitalization is of major importance for health technology design, application, and evaluation.

### 15.2.2 Specifics of Rural Healthcare

Rural areas exhibit several characteristics that influence the applicability and necessity of digital interventions as a supplement for care processes and structures. In addition, the given rural circumstances potentially shape the way people perceive, adopt, and use technologies implemented to support treatments and enable access to care.

Healthcare issues in rural areas appear in different forms. For instance, environmental, geographical, and infrastructural circumstances can lead to adverse and inequitable spatial distributions of care facilities and professionals [36]. Patients as well as physicians are obliged to travel long distances either to consult a professional or to visit patients in need of care at home [3, 7]. Furthermore, many physicians and young medical graduates tend to practice in urban or suburban areas [30]. The rural exodus of healthcare professionals, inter alia, is driven by a huge (on-call) demand for care while supply is scarce, leading to exhaustion and work-life-balance issues [33], and (perceived) benefits of structurally stronger regions such as the quality of education [37], attracting physicians to settle. In addition, rural areas suffer from inferior access to specialized and appropriately educated healthcare providers as opposed to urban areas [15]. Hence, the rural population faces greater issues regarding the availability of specialized practitioners (e.g., cardiologists), leading to a lack of supply beyond treatment of common diseases and basic care. Further, studies report on barriers towards healthcare that rural areas struggle more with compared to urban areas. Besides others, resource limitations (e.g., the lack of colleagues that physicians can consult for council), confidentiality limitations (i.e., concerns about reporting sensible data to authorities), and overlapping roles (i.e., physicians meeting clients in private life contexts) are increasingly noticed [3]. As a result, disparities with regard to access to care and population-wide health status emerge [28] and "[…] traditional concerns about access to primary and hospital care continue to dominate rural health policy" [12] (p. 1675).

However, while potentially delivering benefits for maintaining a comprehensive care in the near future, technologically supported treatments come with challenges. For instance, digital tools require a certain degree of skill and efficacy, rendering a proportion of patients and physicians unable to use them. Especially in times of ageing societies, which particularly emerge in many rural areas across both developed and developing countries [2, 8, 39], this issue becomes apparent and calls for higher involvement and guidance [14, 25]. In addition, valuation of technology is often rooted in social cues and opinions that affect users' adoption and use behavior. This effect is potentially reinforced by rural structures, where health literacy can be low [38] and trust often solely roots in statements and assessments by professionals [13]. This can impede the effectiveness of health information delivered by technologies. However, as studies have shown, the willingness and confidence to use telemedical systems does not significantly differ when comparing rural and urban populations [11], showing that the path for telemedical systems in healthcare can be made once sufficient education is provided and awareness granted [21].

The circumstances found in rural areas and populations described above illustrate the need for a dedicated investigation of rural areas as a reasonable space for digitalization. Literature has unveiled significant issues and barriers healthcare providers as well as consumers have to deal with, further motivating the study at hand. Apparently, physicians are facing major challenges when providing comprehensive care, reinforcing the issues associated with the future application of health technologies for patient treatment. Their perspectives on the potentials as well as constraints of health technologies are identified as a major scientific and practical demand.

## 15.3 Methods

### 15.3.1 Case Description

We conducted a qualitative study involving seven semi-structured interviews with primary care physicians. The study took place within a regional project on digitalization of primary care practices and processes. One major focus is the investigation of health technology acceptance by rural primary care physicians, which are potentially obliged to implement, adopt, and continuously use technological tools in the near future due to declining amounts of accessible physicians. Here, the perceived influence and impact of digital tools on the patient-physician relationship, the treatment process, and the physicians' performance form promising predictors of technology acceptance and adoption behavior.

The technological setting that our empirical investigation is based on consists of three incremental versions of a telemedicine system for patient communication, treatment, and diagnosis: (1) Establishing a live video conference between a spatially separated physician and patient, enabling face-to-face communication and basic examinations (e.g., check for wounds or skin abnormalities via webcam). (2) Enhancing the video solution with body-worn sensors that are able to measure relevant vital parameters (e.g., blood pressure). The captured data can be transmitted to the physician without temporal restrictions, enabling an immediate inspection by the physician. As a result, the physician can adjust the treatment and, if needed, arrange a physical meeting. (3) Analyzing the data right after its acquisition, for instance by using Artificial Intelligence (AI) algorithms that pre-analyze the data before the results are transferred. Consequently, the physician has the option to only receive information gathered from the raw data, such as incidents where given vital parameters surpass critical thresholds and call for intervention. This contains the potential to save valuable time since the expert does not have to look through all the data arriving throughout the day.

### 15.3.2 Data Collection and Analysis

The seven interviews took between 50 and 120 minutes (75 minutes on average) and were conducted on the physician site. We followed a convenient sampling approach. Interviewees were recruited via a regional governmental gatekeeper reaching out to physicians willing to participate in the aforementioned project. The sample yielded three female and four male interviewees. Interviewees were aged between 41 and 66 years (52 years on average) and had between 15 and 34 years (25 years on average) of job experience as a physician. Due to the recruitment process, all participants were located in the same region dealing with comparable circumstances. As a prerequisite to gather meaningful and rich data, all participants exhibit a sufficient degree of technical affinity and interest enabling them to fathom the technological setting and potential impacts.

The participants were interviewed in two blocks on two consecutive days due to temporal limitations originating in the physicians' time schedule and obligations. The interview guideline was not changed between sessions, representing a non-iterative procedure. This led to an ex post data analysis that was performed after the last interview had been conducted. In doing so, we tried to increase variance in physician perceptions while reducing bias by extending interviews with previous findings.

The interview process consisted of two phases. In phase one, the interviewees were asked about their general opinion on the state of rural healthcare, associated opportunities and challenges for change, and their own job related conditions. In addition, we asked for the participants' view on digitalization, particularly in healthcare and patient treatment. Sample questions are "What chances and risks do you see with regard to progressing digitalization?" or "Are you willing to digitalize your practice in the future?" In phase two, questions revolved around the technical setting described above. After introducing the scenario involving three incremental system versions, interviewees were asked to assess the described digitized setting with regard to feasibility, functionality, usefulness, as well as arising challenges and issues that are associated with implementing and using the system. Sample questions are “Do you consider the described system suitable for daily use?” or “What do you think is important for patients to accept the system?” This two-phased approach allowed us to gradually increase the questions’ reference to digitalization, thus gathering more general as well as specific data on the physicians’ perspectives on health technology. The interviews were conducted in German, audio recorded, and transcribed non-verbatim while containing the meaning and formulation. For the purpose of analysis, the data was translated into English.

For data analysis, we followed a Grounded Theory approach consisting of open, axial, and selective coding [32]. During open coding, interview statements and passages are assigned with (partially in vivo) labels. After that, axial coding seeks to categorize open codes that relate to the same phenomenon and meaning. Finally, selective codes are identified that are able to describe and subsume all axial codes.

The coding procedure was performed in three steps, following and adapting the procedure described by Mueller and Heger [24]. First, two of the authors independently coded the data. This led to two separate schemes including open, axial, and selective codes. Second, the authors discussed and compared their schemes. For that, open and axial codes were reframed, partially renamed, and finally merged into a new categorization scheme. Next, the authors analyzed whether the identified selective codes withstand or new categories arise. This led to a new comprehensive scheme involving 4 selective codes and 9 axial codes. Table [34] shows a coding example. Third, each author re-coded the data according to the agreed coding scheme. Subsequently, the assignment of elaborated codes to the data was discussed once more, resolving disagreements and yielding in a final data coding.

| Open Code | Axial Code | Selective Code |
|---|---|---|
| "In the past [...] you have looked something up in books or magazines, today you visit the Internet. The self-treatment is not wrong, takes place at any time [...]" (Interviewee 6) | Patient Self-Information | Patient Activation |
| "Many [patients] come with [...] the most dramatic and severe they could find [...] and so they arrive already frightened because they can't deal with what they read and ultimately can't classify it." (Interviewee 4) | Patient Insecurity | |

**Table 34: Coding Example**

### 15.4 Findings

Based on the seven interviews, we built four main categories to generalize relevant content regarding our research question: (1) Patient Activation, (2) Impacts on Treatment Process, (3) Patient Differentiation, and (4) Patient-Physician-Interaction. Each main category comprises subcategories, which can be considered as an accumulation of axial codes. To prevent the potential identification of interviewees, for instance by delineating interviews by means of their order, we assigned each interviewee a random number [24].

#### 15.4.1 Patient Activation

We divided the main category Patient Activation into three subcategories: patient self-information, patient insecurity / unwanted framing and patient motivation. The first subcategory patient self-information contains statements about the effects of a digitally assisted confrontation of the patients with their own symptoms or process of disease from the physician’s perspective. Frequently, those statements refer to a patient self-initiated internet research of symptoms before visiting the physician’s practice. The majority of physicians appreciated a proactive informational process of patients: “I even recommend doing a research, but for example I mention patient organization […]. There are even apps for young people from companies containing fantastic information [...].” (Interviewee 7). Two participants highlighted the benefits of a preceded research by the patient because of its impact on a dynamic therapeutic process: “[…] I like that, because it's always good if there is an informed patient than to explain everything from the beginning. Most of the time, patients actually know relatively well what it is about […]” (Interviewee 5) or “[...] Actually, I appreciate it when there is a patient with advance information. This way, you are able to sort things out for them, sort things out with them together.” (Interviewee 2). In contrast, the second subcategory patient insecurity / unwanted framing describes the physician’s view on mostly negative effects from self-initiated internet research. These effects are related to a process of manifesting a special belief or assumption of a possible diagnosis for the patient’s own symptoms or rather pathology: “Well, the middle generation, youths as well, they are reading a lot on Wikipedia and sometimes, as a result, there appear some curious things and of course this is what makes them feel even more insecure […].” (Interviewee 6) or “Most of them got anything from Google. Most of the time, always, it's just the most dramatic and severe they could find. A small pigmentation becomes syphilis and so they arrive already frightened because they can't deal with what they read and ultimately can't classify it.” (Interviewee 4). While Interviewee 4 and 6 describe tendencies of the patient to consider the most pessimistic interpretation of specific symptoms because of a lacking ability to differentiate, one physician mentioned the patient’s general need to interpret their symptoms as a possible explanation: “Sometimes a lot of those stressing reactions are simply masked, people are looking for something to fit their symptoms and don't recognize where it is actually coming from.” (Interviewee 3). The participants described consequences of those unwanted effects as well: “Well, in this way, you always encourage illness-awareness as well, not just health-awareness. That is not good.” (Interviewee 5) or “[…] you are questioned when you don't say the same thing that is on the internet, then you aren't a good physician, I mean then, you didn't think of it as an important thing to mention […]” (Interviewee 3). While the first two subcategories of Patient Activation refer to different facets of an informational process, patient motivation characterizes an actual intention to act due to collected information or technological opportunities. Physicians portrayed hypothetical and present motivational effects relating to digital technology, e.g., a shortened time period until a therapy might start or the time-saving use of online requests for prescriptions: “[…] but some might come earlier, so that they don't delay three weeks, but have a shorter way […]” (Interviewee 3) or “[…] but also elderly patients manage to use it well or ask their relatives for help and don't make their request personally here in our practice, but the electronic way is used more and more.” (Interviewee 2). Built from the subcategories, Patient Activation comprises patients’ use of technologies to self-manage their own symptoms or process of disease with different outcomes on a therapeutic situation concerning physician and patient, while the physicians' perspectives include hypothetical and actual effects.

### 15.4.2 Impacts on Treatment Process

We divided Impacts on Treatment Process into the subcategories effort reduction/increase and technological reliability. While the hypothesis appears appropriate, that nearly any factor concerning the digitalization of primary care practices might influence the treatment process itself, some aspects of the mentioned subcategories were stated explicitly in the interviews. In our first subcategory, physicians state their believes and experiences in terms of beneficial or adverse use of digital technologies as well as perceived technological boundaries for therapy. On the one hand, high expectations of positive technological effects are mentioned: "[a faster] communication […] with a safe connection, that would make work easier." (Interviewee 6) or "With help from telemedicine technology you could spare some time…he [the patient] doesn't have to come, I don't have to visit…that's a real advantage." (Interviewee 5). In this context, not only aspects of a time-winning communication were referred to, but also hypothetical advantages of new data infrastructures: "[…] you got access to patient's data fast, e.g., from a cloud […]" (Interviewee 6) or "Home visits cost a lot of time. If you are able to select by necessity […] you could save a lot of time." (Interviewee 1). On the other hand, sceptical quotes were extracted from the interviews. Participants worried about additional efforts caused by new technology: "All in all it [telemedicine] might be useful for trivialities, but the time it takes might exceed the time I spend during consultation hours." (Interviewee 6) or "If you have to differentiate it [data] yourself in the first place, I don't know if it really is time saving." (Interviewee 6) or "No, it's not helpful. It [patient's insecurity through internet research] takes time." (Interviewee 7). One physician concludes that complexity and usability of technology might be a reason for reservation: "It is [online appointment allocation] not wanted in our practice, because it's said that nobody is able to operate it, to manage it technically." (Interviewee 3). Furthermore, one physician drew parallels to a consumer-oriented self-conception of patients causing additional efforts: "[…] if every patient […] has the right to consult his physician via monitor, you are faced with an uncontrollable flood of demands. That won't work of course." (Interviewee 5). Conclusively, physicians formulate technological reliability as an important factor concerning Impacts on Treatment Process. Differentiated from possible boundaries, a lack of security actually worries or scares the interviewees: "Strangers having access to data or misusing data, possibly having different interests than our patients."

(Interviewee 1) or “I'm noticing a huge risk in not realising a decent data security.” (Interviewee 5) or “Privacy, that is important […] see what's already been hacked, we're scared of course.” (Interviewee 4). Together, both mentioned subcategories explicate conditions and hypothetical effects of a medical digitalization from the physicians’ point of view, illustrating technology-related expectations.

### 15.4.3 Patient Differentiation

During the interviews, physicians outlined specific differences between potential or actual users of healthcare-related digital technology. We merged those contents to our third main category Patient Differentiation, including the two subcategories case dependency/characteristics and stereotyping. While the first category contains statements in which physicians explained or justified a differentiated hypothesis about patient’s use of technology, the second category includes heuristic and generalized statements about a large group of patients or people. As an example for the first subcategory case dependency/characteristics, one physician emphasizes individual technical skills and competencies of their patients: “That's [use of online requests for prescriptions] totally various. Most of our patients under 30, of course, but our elderly patients […] as well […] are getting help from their relatives […]” (Interviewee 2). Additionally, physicians differentiated the benefit of technology use with regard to specific patient groups, e.g., known/unknown patients, chronical/non-chronical patients, and severe/non-severe diseases: “Concerning chronical patients it [telemedicine] might be useful […]. As said before, in exceptional cases […] for bedridden patients, patients with a severe disease […]” (Interviewee 5). Besides type and seriousness of disease, the status of a personal relationship between physician and patient was seen relevant: “Anyway, I would only consider it [telemedicine] useful for patients I already know. Where I know their surroundings.” (Interviewee 1). One physician expressed their idea of filtering patients that might be able to use and accept telemedicine services: “Eventually, you need someone to select those patients fitting […]” (Interviewee 3). Another participant concludes a need for individually configurable algorithms analysing patient data: “Geriatric patient’s measurements […] it needs different thresholds […] I should be able to determine a threshold value for an algorithm […] a standardized configuration, that's not possible.” (Interviewee 2). Unlike examples of underlining individual characteristics of patients’ technological competencies, several statements of the participants generalize patient groups in terms of their age or place of residence: “In urban areas I envisage a use of online appointment allocation […]. Here, that's not possible.” (Interviewee 6) or “Our generation, surely [accept telemedicine services] but not elderly people, they struggle with those things.” (Interviewee 3) or “I think it depends on their age [use of telemedicine services]” (Interviewee 3). As well as the other two main categories, Patient Differentiation shows an ambiguity between individualizing and generalizing patient characteristics.

### 15.4.4 Patient-Physician-Interaction

In our last main category, we explicate the physicians’ statements concerning their experience in their therapeutic relationship to a patient. In contrast to Impact on Treatment Process, the category Patient-Physician-Interaction does not include general aspects but ones of direct, situated interaction between patient, physician, and technological artefacts. We divided this category into the two subcategories physician-patient collaboration and personal/bodily contact. The first subcategory concerns strategies to actively deal with a modified informational state of patients using online sources to fathom their symptoms: “Everyone has ideas about something. I've got my ideas as well and as a consequence […] we try to bring them together […]” (Interviewee 6) or “I'm telling my patients: You might read everything you like, write it all down, but visit me afterwards and talk with me about it.” (Interviewee 7). In this context, one physician pointed out the need to accept the patient’s own research to integrate it into the therapeutic process: “That [patient's worry about self-researched symptoms] is just the way it is - you have to take care of it, you have to sort things out.” (Interviewee 4). Therefore, physicians state in which ways they deal with effects of modern information technology (as mentioned within the main category Patient Activation). While it might appear conceivable that the participants mention similar solutions for other technological novelties, especially telemedicine services are considered more of a limiting aspect for interaction. Physicians underline the consequent lack of personal or bodily contact constituting the second subcategory: “When complex problems occur, it is sometimes important, to have personal contact […] that means to meet the person and see his surroundings.” (Interviewee 1). Two physicians described their intuitional perception of a patient as an important factor for diagnosis and the lack of it using telemedicine systems: “You are feeling it, don't you? And that's absent in a video […] you can't touch him or her [patient].” (Interviewee 6) or “And […] I don't feel the patient. I can't describe it […] you got a feeling that is appropriate most of the time." (Interviewee 6). The decrease of social interaction within a therapeutic process through a telemedicine system appeared to be another possible reason for a rejecting position: “Because personal contact is very important, especially for elderly patients or those in need of home visits being helpless […]" (Interviewee 2). One physician summarized the perceived disadvantages: "Generally, contact between physician and patient is always important […] the way somebody speaks, acts, walks through the door…are things a video can't show […]" (Interviewee 5). While these statements sound resolute, more relativizing perspectives can also be reported from one interview: "[…] sometimes it is important to touch a patient. It doesn't have to be at the first visit, but it has to be possible some time during the treatment process […]" (Interviewee 2) and "[…] because fundamental trust is necessary, you can't gain it electronically and for patient's treatment it is mandatory." (Interviewee 2). Hence, our last main category describes a physician's direct involvement with challenges arriving through aspects of medical digitalization, differentiated in already experienced solution strategies and hypothetical limits of telemedicine services.

### 15.5 Discussion

Noteworthy, physicians contrasted the patients' self-management in the form of self-initiated research concerning symptoms or their process of disease through (1) more positively perceived and (2) more negatively perceived Patient Activation. One might assume that from the physicians' perspective, the outcome of a patient's self-initiated process of information, which can be viewed as a digitally assisted empowerment, depends on his ability to select, sort, and analyze information relating to their symptoms or process of disease. While a neutrally informed patient appears to be preferable, a deep analysis of information might frame a patient so sustainably, physicians actually perceive a need to revise the patient's belief resulting in a time-costly effort and/or a negative effect on the relationship between patient and physician. To reconstruct a patient's self-initiated informational process might be an interesting approach for future work to understand motives and motivations, probably on a way to a self-made diagnosis. Subsequent work might be able to formulate implications for a precise and self-reflected way for patients to gather health-related information affecting themselves or relatives.

By means of the second main category, Impacts on Treatment Process, the physicians' expectations related to digital technology use in practice can be described simultaneously. Concerning our interviews, the main factor to measure reduction or increase of effort might be the time spent on a specific task. Due to the fact that many physicians in rural areas have a high case ratio, a deducted hypothesis might be that the benefit of digital technology and the intention to use it depend on the actual time saved or caused by it. As a factor probably predicting a physician's intention to use health-related digital technology or as a measure of technological usability, 'time spent on a specific task' might be considered as a variable in future studies (especially as a pre-post comparison), but not without critically reflecting on an increase in efficacy for merely economic reasons.

With regard to a differentiated view on a patient's technological abilities and intentions, physicians considered the individual use of technology they already knew (e.g., online requests for prescriptions) or thought helpful (e.g., telemedicine services for well-known patients), positive in some cases. Considering a specific technological novelty not practical or useful, physicians underlined basic differences between patient groups (e.g., old vs. young). Cautiously hypothesized from quotes of our main category Patient Differentiation, physicians might sometimes justify a misuse of technology with stereotypes or generalized statements about their patients. Discussing stereotypes as well as perceived barriers of technological use and clarifying actual technical obstacles might be taken into account as an important aspect of health-related technological implementation and practice.

Statements from the main category Patient-Physician-Interaction demonstrate a physician's strategy to adopt technological aspects concerning their relationship with patients directly. To deal with partially worrying or misinterpreted information patients gather from online research, physicians formulated an understanding dialogue or process of negotiation as a possible solution. This might be considered an interesting example for an adaption of digital-technological change into the relationship between physician and patient. Besides, physicians seem to consider a personal or bodily presence of the patient an essential component of the relationship between patient and physician. Despite relativization, absence might function as a limiting factor of technological novelties and their implementation. This result can be seen as a possible impulse to increase theoretical work on phenomenological approaches to digital technology in healthcare, as it already is discussed in the medical field [4]. Similarly, specific technological requirements, such as the necessity to see the patient within their surroundings (i.e., not isolated from it) or to experience a haptic feedback, are implicitly stated in our interviews. For us, especially the seeming contradiction of telemedicine services and sophisticated primary care is considered an innovative and challenging field for future work.

### 15.6 Conclusion & Outlook

Following our research question, we examined factors constituting physicians' perspectives on patient empowerment through digital technology. Findings of seven interviews with primary care physicians suggest that level and quality of informational knowledge attained through online resources affect the view on a patient. While an objective and reserved handling of information by the patient is seized as an improving factor, physicians may consider a restricted belief about a patient's own symptoms disruptive. Additionally, the interviewees valued the usability of digital health-related technologies as well as possible resulting empowerment of patients according to the effort of time needed to fulfill a task with or without its help. Furthermore, the interviewed physicians classified patients' capabilities of technology use due to their individual or general characteristics (e.g., morbidity, age). As a constituting factor, physicians described the direct effect of technology on a personal (bodily) relationship between themselves and their patients.

Our empirical study underlies some limitations. First, we did not differentiate our sample and the gathered data by areas of expertise and potential specializations. Whereas all of the interviewees are practicing in primary care, some of them are specialists in certain areas (e.g., diabetes). In addition, prior studies identified age influencing IT adoption and assessment [25], which we did not factor in as well. Further, all participants reside in the same area, thus neglecting potential regional differences (e.g., with regard to population size and characteristics). Considering these differences during data collection and analysis could yield new insights. Second, we have engaged a rather small sample size using a convenient approach, affecting the external validity of our findings. Addressing a wider population, for instance by deploying quantitative methods such as broad surveys, yields more generalizable insights.

Our study at hand opens up several future research opportunities. First, our findings motivate the formulation of hypotheses testing the effect identified factors (i.e., main categories) have on important dependent variables such as behavioral use intentions and actual IT adoption and use behavior. For instance, perceived patient insecurity occurring when using health technologies might negatively influence physicians' intentions to use such a system. Second, the investigation of patient-sided perspectives on the digitalization of treatments and the accompanying empowerment through digital tools can deliver novel, complementary, or even conflicting insights. The comparison of health consumers and providers, thus, represents a fruitful avenue for subsequent studies.

## 15.7 References

[1] Ahmad, F., P.L. Hudak, K. Bercovitz, E. Hollenberg, and W. Levinson, “Are Physicians Ready for Patients With Internet-Based Health Information?”, Journal of Medical Internet Research 8(3), 2006, pp. e22.

[2] Apt, N.A., “Ageing and the changing role of the family and the community: An African perspective”, International Social Security Review 55(1), 2002, pp. 39–47.

[3] Brems, C., M.E. Johnson, T.D. Warner, and L.W. Roberts, “Barriers to healthcare as reported by rural and urban interprofessional providers”, Journal of Interprofessional Care 20(2), 2006, pp. 105–118.

[4] Carel, H., “Phenomenology and its application in medicine”, Theoretical Medicine and Bioethics 32(1), 2011, pp. 33–46.

[5] Castro, E.M., T. Van Regenmortel, K. Vanhaecht, W. Sermeus, and A. Van Hecke, “Patient empowerment, patient participation and patient-centeredness in hospital care: A concept analysis based on a literature review”, Patient Education and Counseling 99(12), 2016, pp. 1923–1939.

[6] Chau, P.Y.K., and P.J.-H. Hu, “Investigating healthcare professionals’ decisions to accept telemedicine technology: an empirical test of competing theories”, Information & Management 39(4), 2002, pp. 297–311.

[7] Currie, M., L.J. Philip, and A. Roberts, “Attitudes towards the use and acceptance of eHealth technologies: a case study of older adults living with chronic pain and implications for rural healthcare”, BMC Health Services Research 15(1), 2015, pp. 162–174.

[8] Davis, S., and H. Bartlett, “Healthy ageing in rural Australia: Issues and challenges: Rural healthy ageing”, Australasian Journal on Ageing 27(2), 2008, pp. 56–60.

[9] Demiris, G., and B.K. Hensel, “Technologies for an aging society: a systematic review of ‘smart home’ applications”, Yearbook of medical informatics 17(01), 2008, pp. 33–40.

[10] Emanuel, E.J., and L.L. Emanuel, “Four models of the physician-patient relationship”, JAMA 267(16), 1992, pp. 2221–2226.

[11] Grubaugh, A.L., G.D. Cain, J.D. Elhai, S.L. Patrick, and B.C. Frueh, “Attitudes Toward Medical and Mental Health Care Delivered Via Telehealth Applications Among Rural and Urban Primary Care Patients”:, The Journal of Nervous and Mental Disease 196(2), 2008, pp. 166–170.

[12] Hartley, D., “Rural Health Disparities, Population Health, and Rural Culture”, American Journal of Public Health 94(10), 2004, pp. 1675–1678.

[13] Hojat, M., D.Z. Louis, K. Maxwell, F. Markham, R. Wender, and J.S. Gonnella, “Patient perceptions of physician empathy, satisfaction with physician, interpersonal trust, and compliance”, International Journal of Medical Education 1, 2010, pp. 83–87.

[14] Jimison, H., P. Gorman, S. Woods, et al., “Barriers and drivers of health information technology use for the elderly, chronically ill, and underserved”, Evid Rep Technol Assess (Full Rep) 175, 2008, pp. 1–1422.

[15] Johnson, M.E., C. Brems, T.D. Warner, and L.W. Roberts, “Rural–Urban Health Care Provider Disparities in Alaska and New Mexico”, Administration and Policy in Mental Health and Mental Health Services Research 33(4), 2006, pp. 504–507.

[16] Karsh, B.-T., M.B. Weinger, P.A. Abbott, and R.L. Wears, “Health information technology: fallacies and sober realities”, Journal of the American Medical Informatics Association 17(6), 2010, pp. 617–623.

[17] Kayser, L., A. Kushniruk, R.H. Osborne, O. Norgaard, and P. Turner, “Enhancing the Effectiveness of Consumer-Focused Health Information Technology Systems Through eHealth Literacy: A Framework for Understanding Users’ Needs”, JMIR Human Factors 2(1), 2015, pp. e9.

[18] Kvedar, J., M.J. Coye, and W. Everett, “Connected health: a review of technologies and strategies to improve patient care with telemedicine and telehealth”, Health Affairs 33(2), 2014, pp. 194–199.

[19] Luxton, D.D., R.A. McCann, N.E. Bush, M.C. Mishkind, and G.M. Reger, “mHealth for mental health: Integrating smartphone technology in behavioral healthcare”, Professional Psychology: Research and Practice 42(6), 2011, pp. 505–512.

[20] Martínez, A., V. Villarroel, J. Seoane, and F. Pozo, “Rural telemedicine for primary healthcare in developing countries”, IEEE Technology and Society Magazine 23(2), 2004, pp. 13–22.

[21] Meher, S.K., R.S. Tyagi, and T. Chaudhry, “Awareness and attitudes to telemedicine among doctors and patients in India”, Journal of Telemedicine and Telecare 15(3), 2009, pp. 139–141.

[22] Meyer, J., S. Simske, K.A. Siek, C.G. Gurrin, and H. Hermens, “Beyond quantified self: data for wellbeing”, CHI’14 Extended Abstracts on Human Factors in Computing Systems, ACM Press (2014), 95–98.

[23] Misra, V., A. Bozkurt, B. Calhoun, et al., “Flexible Technologies for Self-Powered Wearable Health and Environmental Sensing”, Proceedings of the IEEE 103(4), 2015, pp. 665–681.

[24] Mueller, M., and O. Heger, “Health at Any Cost? Investigating Ethical Dimensions and Potential Conflicts of an Ambulatory Therapeutic Assistance System through Value Sensitive Design”, Proceedings of the 39th International Conference on Information Systems (ICIS), San Francisco, USA, 2018.

[25] Niehaves, B., and R. Plattfaut, “Internet adoption by the elderly: employing IS technology acceptance theories for understanding the age-related digital divide”, European Journal of Information Systems 23(6), 2014, pp. 708–726.

[26] Osei-Frimpong, K., A. Wilson, and F. Lemke, “Patient co-creation activities in healthcare service delivery at the micro level: The influence of online access to healthcare information”, Technological Forecasting and Social Change 126, 2018, pp. 14–27.

[27] Pantelopoulos, A., and N.G. Bourbakis, “A Survey on Wearable Sensor-Based Systems for Health Monitoring and Prognosis”, IEEE Transactions on Systems, Man, and Cybernetics 40(1), 2010, pp. 1–12.

[28] Politzer, R.M., J. Yoon, L. Shi, R.G. Hughes, J. Regan, and M.H. Gaston, “Inequality in America: The Contribution of Health Centers in Reducing and Eliminating Disparities in Access to Care”, Medical Care Research and Review 58(2), 2001, pp. 234–248.

[29] Risk, A., and C. Petersen, “Health information on the internet: quality issues and international initiatives”, Jama 287(20), 2002, pp. 2713–2715.

[30] Rosenblatt, R.A., and L.G. Hart, “Physicians and rural America”, Western Journal of Medicine 173(5), 2000, pp. 348.

[31] Sittig, D.F., and H. Singh, “Legal, Ethical, and Financial Dilemmas in Electronic Health Record Adoption and Use”, PEDIATRICS 127(4), 2011, pp. e1042–e1047.

[32] Strauss, A.L., and J.M. Corbin, Basics of qualitative research: techniques and procedures for developing grounded theory, Sage Publications, Thousand Oaks, 1998.

[33] Thommasen, H.V., C.M. Lavanchy, C.I. Connelly, J. Berkowitz, and S. Grzybowski, “Mental health, job satisfaction, and intention to relocate. Opinions of physicians in rural British Columbia”, Canadian Family Physician 47(4), 2001, pp. 737–744.

[34] Van Woerkum, C.M., “The Internet and primary care physicians: coping with different expectations”, The American Journal of Clinical Nutrition 77(4), 2003, pp. 1016–1018.

[35] Wiederhold, B.K., “mHealth Sensors Can Promote Behavior Change and Reduce Healthcare Costs”, CyberPsychology, Behavior & Social Networking 18(10), 2015, pp. 559–560.

[36] Wilson, N., I. Couper, E. De Vries, S. Reid, T. Fish, and B. Marais, “Inequitable distribution of healthcare professionals to rural and remote areas”, Rural Remote Health 9(1060), 2009.

[37] Yang, J., “Potential urban-to-rural physician migration: The limited role of financial incentives”, Canadian Journal of Rural Medicine 8(2), 2003, pp. 101–106.

[38] Zahnd, W.E., S.L. Scaife, and M.L. Francis, “Health literacy skills in rural and urban populations”, American journal of health behavior 33(5), 2009, pp. 550–557.

[39] Zhong, H., “The impact of population aging on income inequality in developing countries: Evidence from rural China”, China Economic Review 22(1), 2011, pp. 98–107.

# 16 Perceived Limitations of Telemedicine

| | |
|---|---|
| Title | **Perceived Limitations of Telemedicine from a Phenomenological Perspective** |
| Number | **P10** |
| Authors | Michael Knop[1]<br>Marius Müller[1]<br>Henrik Freude[1]<br>Caroline Reßing[1]<br>Björn Niehaves[1]<br><br>[1]University of Siegen<br>Kohlbettstraße 15<br>57072 Siegen |
| Publication Type | Conference Proceedings |
| Publication Outlet | Bled eConference |
| Status | published |
| Full Citation | Knop, M., Mueller, M., Freude, H., Reßing, C., Niehaves, B. (2020), “Perceived Limitations of Telemedicine from a Phenomenological Perspective”, 33rd Bled eConference, Maribor, Slovenia. |

**Table 35: Publication Overview (P10)**

# Perceived Limitations of Telemedicine from a Phenomenological Perspective

*Abstract*: In the course of healthcare digitization, the roles of therapists and patients are likely to change. To shape a theoretical based process of technological transformation, a phenomenological perspective on Information and Communication Technology (ICT) is introduced. Therefore, this paper illustrates the benefit of a holistic view on patients and therapists to describe and explain phenomena concerning Human Technology Interaction (HTI). The differentiation between a measurable objective body and a habitual subjective body helps to evaluate and anticipate constituting factors of accepting telemedicine systems. Taking into account findings from a secondary analysis of semi-structured interviews we conducted with primary care physicians, we develop a phenomenological framework for HTI in healthcare. Our aim is to structure future research concerning design implications for ICT and the implementation of telemedicine systems in clinical and primary care.

*Keywords*: Telemedicine, Phenomenology, Acceptance, Human Technology Interaction, Information and Communication Technology

## 16.1 Introduction

As digitization of healthcare services proceeds, different challenges of care are going to be addressed by Information and Communication Technology (ICT), robots, sensory technology, or virtual reality (Krick et al. 2019). Therapists therefore face implementations of care-related technologies and are in need of balancing structural and technological change, professional identity, and a different relationship with patients (Fuller and Hansen 2019). Furthermore, the digitization of healthcare is linked to promises of efficient and innovative care (Hollis et al. 2015) as well as an increasing quality of medical treatments (Mutter et al. 2005). Telemedicine systems appear to play a significant role in the digitization of healthcare, as they are capable of reducing spatial and temporal limitations (Kvedar et al. 2014). Especially in rural areas, telemedicine systems might therefore address rising issues of medical undersupply as a consequence of demographic changes, age related multimorbidity (Demiris and Hensel 2008), and an exodus of healthcare professionals (Thommasen et al. 2001). Although many scientific results point out positive effects of digital technologies in healthcare, theoretical founded research is still rare (Garrett et al. 2018). To shape a theoretically driven process of technological change that can be accepted and catalyzed by both therapists and patients, it is of great interest to understand design-implicating factors of digital technology while taking into account the highly complex patient-therapist relationship and its constituting characteristics. Öberg et al. (2018) e.g. illustrate the necessity to reflect digitization processes in clinical care, as digital technologies are able to cause temporal stress of therapists, affect the relationship between care-giver and care-receiver, and reshape the professional identity of therapists.

To base upcoming research on a theoretical fundament, we propose a phenomenological framework that we build from qualitative empirical insights on Human Technology Interaction (HTI) to formulate implications for design as well as perceived limitations of technology. In IS research, phenomenological perspectives seem to be existent but are underdetermined. For instance, Schultze (2010) states that "the body serves as a frame of reference for the neural processes of the mind" (p. 436) whereof she indirectly proposes a distinguishable nature of the person. In contrast, when Schultze (2010) mentions "what we know about the world is embodied" (p. 436), a phenomenological view on human experience is reflected. Therefore, the objective of this paper is to develop a theoretical framework based on phenomenological assumptions concerning the interaction between humans and healthcare technologies. Assuming that a phenomenological perspective on HTI is already existent in IS research, but not differentiated appropriately, the following paper discusses our process of building such a theoretical framework and explore potentials for describing, explaining and predicting relevant phenomena in IS research.

## 16.2 Theoretical Background

Phenomenology can be considered a philosophical perspective on the process of gaining knowledge. It might as well be described as a method to obtain ἐπιστήμη (epistimi), which can be translated to 'realization' or 'science'. Stating an insuperable difference between a logical deduction concerning a phenomenon and the real state of the phenomenon, the epistemic objective is translocated from the phenomenon itself to the process of its understanding (Husserl 2019). From this paradigm, phenomenology has affected the development of several scientific methods to collect and analyze data, especially in qualitative research (Neubauer et al. 2019). Therefore, in the research of HTI in healthcare, phenomenology is foremost utilized for methodological issues (Newland et al. 2018; Rosenberg and Nygård 2017). Derived from its general perspective, phenomenology can be applied to scientific research in terms of a theoretical framework as well. It promises an understanding and explanation of human experience, e.g., a patient's experience of a digitally assisted attendance at a physician's practice. Carel (2011) explains the phenomenological view on human experience implying that experience is "founded on perception" (p. 35), where "Perception [sic!], in turn, is itself embodied activity" (p. 35). In this manner, perceived stimuli of a patient can be seen as contextual and interpretable (Liberati 2019), as well as bodily manifested (Mingers 2001). While enhancing a therapeutic process through digital technology, one might ask:

How exactly does a digital transformation change the perception and the experience of therapeutic activity of patients and therapists and are phenomenological implications useful to formulate boundaries of digital technology in healthcare?

To understand the impact of these implications completely, it is necessary to describe the theoretical interrelation between a phenomenological perspective on human experience and the meaning of presence for mediated interaction between humans. The concept of presence has been used for decades in IS research to objectify the human experience of virtual worlds. Lombard and Ditton (1997) conclude that presence has several facets but can be basically defined as "the perceptual illusion of nonmediation" (section 6). The definition of Lombard and Ditton (1997) therefore implies a close relationship between presence and perception. Further, considering their conclusion on presence as a multidimensional construct, the dimensions transportation, impression of translocation, and immersion, the degree of submergence into an artificial environment, appear to be one of the most important characteristics for telemedicine mediated patient-physician interaction (Skalski 2011). In the context of healthcare, several studies emphasize the importance of presence for clinical effectiveness and consider presence a main constituting factor for a realistic artificial environment (Garrett et al. 2018; Londero et al. 2010; Price and Anderson 2007; Riva et al. 2002; Viciana-Abad et al. 2004). To ensure a multidimensional feeling or sense of presence, the creation of a mediated reality is oriented on an asymptotic convergence of the artificial and the real world (Heeter 1992). Similarly, perception can be thought of as a multidimensional construct as well. Loomis (1992) argues for a more subjective view on perception while stating that the 'real' world is generally mediated, which leads to the differentiation of naturally and artificially mediated worlds or environments. The realization of a world constructed through our senses (Loomis calls it the "phenomenal world") helps us to understand why technologically mediated experience is capable of activating an actual sense of perception. Nonetheless, it is important to note that there still is a difference between a natural, directly mediated interaction and an artificially, technology-driven interaction.  A phenomenological perspective on such a complex interaction helps to enlarge our understanding by expanding the interrelation between presence and perception through the relevance of experience, e.g. a diagnostic or interventional process. From a phenomenological view, experience itself is bound to the bodily characteristics of humans because the body is the foundation of our perception (Carel 2011). The subjective nature of perception, that can be deduced from Loomis (1992), and the corresponding subjective nature of experience emerging from the phenomenological perspective, lead to the “body as lived” (Carel 2011, p. 33): an impression of the human body that can only be experienced and is highly contextual. Nonetheless, measurement and normalization of the human body creates an objectiveness of the body. The result is a dualism of the human body (Carel 2011).  Although techniques and technologies exist to measure objective data of the human body (that is medical data), an interpretation of the data is closely linked to an experience of such a measurement. In our context, the relationship and interaction between physician and patient creates a defined space for a joint experience. Findings from our empirical investigations therefore reflect the distinction of a subjective and objective body and help us understand that the use and acceptance of specific technologies, such as telemedicine systems, are embedded in specific contexts.

## 16.3 Method

In our primary study to explore factors influencing a digitally enhanced relationship between patient and therapist (Mueller et al. 2020) we conducted seven semi-structured interviews with primary care physicians in rural areas to explore their perception on healthcare digitization, especially on potentials of telemedicine systems. Therefore, our major focus of the interviews was physicians’ technology acceptance of such telemedicine systems. The interviews took 75 minutes on average. We engaged three female and four male interviewees. In our convenient sample, age ranged between 41 and 66 years (mean 52), while job experience ranged between 15 and 34 years (mean 25). In the main part of our interviews, we discussed the use of three different telemedicine systems (capable of 1. basic audio-visual communication, 2. audio-visual communication and real-time transfer of medical patient data via specific sensors, 3. the aforementioned features, but with automatized pre-analysis of medical patient data). To explore circumstances under which therapists tend to accept or reject the implementation of digital technology, we asked the participants about their hypothetical use of these telemedicine systems in their own practice. Exemplary questions were “What kind of benefits or risks do you expect from a telemedicine system?” or “Under which circumstances would you likely accept such a telemedicine system?”. In our process of primary analysis, we noticed that physicians basically tend to reject a specific telemedicine system when they had the impression that the telemedicine system limited their own sensory perception of the patient (Mueller et al. 2020). To follow up on our impression that a limited perception through digital technology might lead to a physician’s rejection of telemedicine systems, we evaluated the key concept of limiting factors concerning telemedicine system use separately. Originally following an approach with three steps of coding (open, axial, and selective coding) (Corbin and Strauss 2015), we therefore conducted a second, informed analysis of our transcripts and filtered codes that represented limitations of telemedicine systems perceived by physicians. We then examined the content-related accordance between our secondary findings and our theoretical prepositions explicated in section 2.

## 16.4 Findings

As an important insight of the conducted interviews and a result of our secondary analysis, therapists mentioned the importance of a bodily presence of the patient to guarantee therapeutic success. We noticed that therapists considered the absence of bodily presence a main negative aspect of telemedicine systems. Participants especially viewed the inability to make bodily contact as one factor limiting their perception of the patient: “*You are feeling it, don't you? And that's absent in a video* […] *you can't touch* [the patient].” (Interviewee 1) or “*Because personal contact is very important, especially for elderly patients or those in need for home visits being helpless* […]” (Interviewee 7). Noteworthy, the first part of interviewee 1’s quotation points to an intuitional aspect of medical care, reflecting the phenomenon of the (experienced) therapist’s ability to bring several complex medical information into a relevant diagnostic concept. The ability to touch a patient seems to be a part of this process. As interviewee 7’s statement claims the importance of bodily contact as well, another dimension can be noticed from the quotation. An additional social dimension can be considered since humans express their social relation with bodily contact (i.a.). Besides the described general necessity to be able to touch a patient, two participants mentioned the importance of physical contact to better diagnose a patient: “*When someone recently said, ‘I felt dizzy and weak…' - that might be anything. For this, I have to auscultate heart and lungs, I have to palpate him*.” (Interviewee 5) or “*That is most* *important, to palpate* […]" (Interviewee 3). The quotations of interviewees 5 and 3 point out an important fact with regard to the process of a primary care physician's diagnostic process. To actually make a possible diagnosis from relatively unspecific data, i.e., a subjective expression of symptoms made by a patient, the characteristics of diagnostic technologies (e.g., auscultation or palpation) require a direct physical contact to the patient. Therefore, these quotations complement the already mentioned aspect of intuitional affected diagnosis with the physical measurement and interpretation of patient-related medical data. Although intuition describes an opaque process, auscultation or palpation can be viewed as mostly structured and standardized diagnostic processes. Interestingly, this leads to the impression that diagnostic (and interventional) processes are composed of subjective and objective aspects. Furthermore, the bodily presence of patients in a conversation, especially at the first acquaintance, was considered important: "*To gather the medical history I would prefer to talk to a patient face-to-face.*" (Interviewee 4) or "*It's not working without getting to know each other* […] i*t's not possible without personal contact. I can't imagine being able to do sound work without.*" (Interviewee 7). Although the interviewees did not mention detailed reasons for their statements, a social component of the patient-physician relationship evolves especially from the quotation of interviewee 7. The perceived necessity of a patient's bodily presence might be interpreted with regard to the already mentioned complexity of diagnostic processes. To make a reasonable diagnosis, physicians need to gather contextual information about a patient. Especially interviewee 7's quotation leads to the impression that without bodily contact, a reconstruction of a patient's relevant living conditions is not adequate.

### 16.5 Discussion

Following the interpretation of these statements, the perceived limitations of telemedicine technology include (1) a bodily absence of the patient in terms of a lack of body signals, possibly irritating the intuitional perception of the therapist, (2) an inability to shape the social relationship between patient and therapist through bodily contact, and (3) an obstacle to measure necessary physical parameters of the patient. As a constituting factor of a (subjectively perceived) successful relationship between patient and therapist, bodily contact might be something digital technology is per definition not able to replace. A phenomenological perspective on these issues helps to understand that the difference between bodily contact and biomedical measurements in medical care can be used to formulate implications for technological design as well as a reflective orientation for the process of digitization in healthcare. Carel (2011) differentiates an “objective body” and the “body as lived” (p. 33). Both impressions of the body are connected. The “objective body” can be associated with primarily physical characteristics (the auscultation of lungs, measurement of blood pressure etc.) and the “body as lived” with habitual, social, and subjective characteristics. In real-life experience of a person, it seems clear that these two impressions or perceptions of the body cannot be fully separated.

Considering the cited statements of the participants, the perceived limitations of telemedicine technology (regarding the interviewed physicians) can be differentiated. First, there are concerns about the ability of telemedicine technology to render complex physical signals of a patient, associated with the objective body. To counter underlying assumptions of decreasing quality of care and negative effects on the patient-physician relationship, the design of technological artefacts mainly has to consider questions of feasibility and practicability. Second, there are concerns about the ability of telemedicine technology to shape a bodily relationship between patient and physician, associated with the subjective body. In accordance with our theoretical explanations, we propose the following theoretical framework to explicate a phenomenological perspective on our objective:

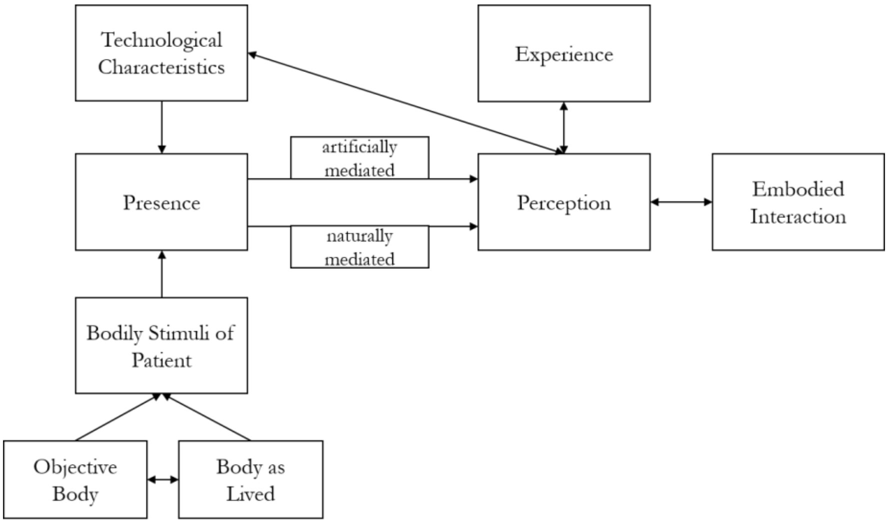


**Figure 6: Therapeutic Interaction between Patient and Physician from a Phenomenological Perspective in the Context of Telemedicine**

From Figure [6], the meaning of a phenomenological perspective on patient-physician interaction and its technological moderation can be derived. First, the differentiation of an objective body and the body as lived helps to understand that the presence and the perception of a patient depends on a contextualization or interpretation of objective medical data (concerning the objective body) through the entirety of bodily stimuli: feelings, emotions, or self-interpretation of a patient are substantial factors to form presence and the perception of a physician. Second, technological characteristics and boundaries change the way physicians perceive the presence of a patient: e.g., visual and auditory quality of telemedicine systems affect an interactive experience of patient and physician. Technological characteristics are able to shape the perception of a physician through artificially mediated presence or in a natural way. Third, perception is bound to our own bodily senses and therefore affected by our embodied interactions. Finally, the interaction between patient and physician (processes of diagnosis or intervention), based on perception, can be considered a bodily experience more than a technological process.

As a result, to evaluate the acceptance of telemedicine technology (in context of both patients' and physicians' use), an important factor from a phenomenological perspective is the context in which the technology is embedded. A separation between reason of design and implementation of technology therefore appears irrational. To anticipate technological acceptance, it is reasonable to consider questions like: what appears to be the main purpose of a specific telemedicine system? Is the telemedicine system used to extend primary care or is it used to replace bodily contact between patient and therapist? From a phenomenological perspective, we deduce two different insights from our findings: (1) the replacement of bodily therapeutic processes with technology mediated processes possibly causes a physician's discontent or resistance to use such a technology. This might be evened through a preferably perfect illusion of bodily interaction. (2) The replacement of a therapeutic process concerning the subjective body of a patient (e.g., the meaning and interpretation of medical data) with a process concerning the objective body of a patient (e.g., algorithm-based thresholds of medical data for medical interventions) possibly causes a physician's discontent.

## 16.6 Conclusion and Outlook

A phenomenological view on digitally enhanced healthcare inspires a reflective discussion about essential constructs of technology use, such as embodiment or presence in the context of telemedicine systems, and their importance for practical implementation. While phenomenological research methods are already present to explore patients' experiences with healthcare technology (Kallmerten and Chia 2019), a phenomenological interpretation concerning antecedents of technology use constitutes an innovative theoretical approach to interpret the interaction between humans and technology. In our context of telemedicine use to overcome spatial and temporal limitations of primary care in rural areas, a phenomenological approach demands a differentiation of specific functions of a telemedicine system. The reflection of human experience that is closely related to our bodily existence, leads to specific implications. The following principles can be interpreted as the most important ones for practice: (1) be careful about replacing a partial process of therapeutic interaction that involves bodily experience with a technology mediated interaction that is not capable of a(n) (almost) perfect illusion of bodily experience. (2) be careful about replacing a partial process of therapeutic interaction that affects both the subjective and the objective body of a patient with a technology mediated interaction that is only capable of affecting the objective body of a patient. These principles occur through (1) the importance of a bodily dimension of human experience and (2) the importance of a contextualization of objective data in medicine. Antecedents derived from these principles might be helpful for both research and practice.

Taking into account the provocative nature of our findings, we are aware that the relatively small sample size of our qualitative research limits the validity of our proposed principles. Hence, for future research, we have to examine the empirical validity of our findings. In a further study about optimization of physician-assistant-delegation, we are going to explore underlying patterns of perceived usefulness through asking healthcare professionals to sequence both everyday and innovative technologies. In a subsequent process, we then use multidimensional unfolding to explore physicians' and physician assistants' perception of similarities and dissimilarities between these technologies. Through additional qualitative interviews with physicians and physician assistants, we like to develop a more differentiated model of our phenomenological approach that can be tested deductively in a comprehensive study. Furthermore, preliminary data from interviews with patients that have been part of telemedical treatment promises additional insights on theoretical relevance from a contrary perspective. Regarding our joint results, we are intending to develop a comprehensive phenomenological framework of HTI to structure future research concerning design implications of ICT and the implementation of telemedicine systems in clinical and primary care.

## 16.7 References

Carel, H. 2011. “Phenomenology and its application in medicine,” Theoretical medicine and bioethics (32:1), pp. 33-46 (doi: 10.1007/s11017-010-9161-x).

Corbin, J. M., and Strauss, A. L. 2015. Basics of qualitative research: Techniques and procedures for developing grounded theory, Los Angeles, London, New Delhi, Singapore, Washington DC, Boston: SAGE.

Demiris, G., and Hensel, B. K. 2008. “Technologies for an Aging Society: A Systematic Review of “Smart Home” Applications,” Yearbook of Medical Informatics (17:01), pp. 33-40 (doi: 10.1055/s-0038-1638580).

Fuller, R., and Hansen, A. 2019. “Disruption Ahead: Navigating and Leading the Future of Nursing,” Nursing administration quarterly (43:3), pp. 212-221 (doi: 10.1097/NAQ.0000000000000354).

Garrett, B., Taverner, T., Gromala, D., Tao, G., Cordingley, E., and Sun, C. 2018. “Virtual Reality Clinical Research: Promises and Challenges,” JMIR serious games (6:4), e10839 (doi: 10.2196/10839).

Heeter, C. 1992. “Being There: The Subjective Experience of Presence,” Presence: Teleoperators and Virtual Environments (1:2), pp. 262-271 (doi: 10.1162/pres.1992.1.2.262).

Hollis, C., Morriss, R., Martin, J., Amani, S., Cotton, R., Denis, M., and Lewis, S. 2015. “Technological innovations in mental healthcare: harnessing the digital revolution,” The British journal of psychiatry : the journal of mental science (206:4), pp. 263-265 (doi: 10.1192/bjp.bp.113.142612).

Husserl, E. 2019. First Philosophy: Lectures 1923/24 and Related Texts from the Manuscripts (1920-1925), Dordrecht: Springer Netherlands.

Kallmerten, P., and Chia, L. 2019. “Health Information Technology (HIT) experiences of the person with Heart Failure (HF): A Descriptive-Interpretive Phenomenological Mini Study,” Nursing Research (68), E184.

Krick, T., Huter, K., Domhoff, D., Schmidt, A., Rothgang, H., and Wolf-Ostermann, K. 2019. “Digital technology and nursing care: a scoping review on acceptance, effectiveness and efficiency studies of informal and formal care technologies,” BMC health services research (19:1), p. 400 (doi: 10.1186/s12913-019-4238-3).

Kvedar, J., Coye, M. J., and Everett, W. 2014. “Connected health: a review of technologies and strategies to improve patient care with telemedicine and telehealth,” Health affairs (Project Hope) (33:2), pp. 194-199 (doi: 10.1377/hlthaff.2013.0992).

Liberati, N. 2019. “Emotions and Digital Technologies,” HUMANA.MENTE Journal of Philosophical Studies (12:36), pp. 292-309.

Lombard, M., and Ditton, T. 1997. “At the Heart of It All: The Concept of Presence,” Journal of Computer-Mediated Communication (3:2), p. 0 (doi: 10.1111/j.1083-6101.1997.tb00072.x).

Londero, A., Viaud-Delmon, I., Baskind, A., Delerue, O., Bertet, S., Bonfils, P., and Warusfel, O. 2010. “Auditory and visual 3D virtual reality therapy for chronic subjective tinnitus: theoretical framework,” Virtual Reality (14:2), pp. 143-151 (doi: 10.1007/s10055-009-0135-0).

Loomis, J. M. 1992. “Distral Attribution and Presence,” Presence (1:1), pp. 113-118.

Mingers, J. 2001. “Embodying information systems: the contribution of phenomenology,” Information and Organization (11:2), pp. 103-128 (doi: 10.1016/S1471-7727(00)00005-1).

Mueller, M., Knop, M., Ressing, C., Freude, H., Oschinsky, F. M., Klein, H. C., and Niehaves, B. 2020. “Constituting Factors of a Digitally Influenced Relationship between Patients and Primary Care Physicians in Rural Areas,” in Proceedings of the 53rd Hawaii International Conference on System Sciences, T. Bui (ed.), Hawaii International Conference on System Sciences.

Mutter, D., Bouras, G., and Marescaux, J. 2005. “Digital technologies and quality improvement in cancer surgery,” European journal of surgical oncology : the journal of the European Society of Surgical Oncology and the British Association of Surgical Oncology (31:6), pp. 689-694 (doi: 10.1016/j.ejso.2005.02.031).

Neubauer, B. E., Witkop, C. T., and Varpio, L. 2019. “How phenomenology can help us learn from the experiences of others,” Perspectives on medical education (8:2), pp. 90-97 (doi: 10.1007/s40037-019-0509-2).

Newland, L. A., Mourlam, D., and Strouse, G. 2018. “A Phenomenological Exploration of the Role of Digital Technology and Media in Children’s Subjective Well-Being,” Child Indicators Research (11:5), pp. 1563-1583 (doi: 10.1007/s12187-017-9498-z).

Öberg, U., Orre, C. J., Isaksson, U., Schimmer, R., Larsson, H., and Hörnsten, Å. 2018. “Swedish primary healthcare nurses' perceptions of using digital eHealth services in support of patient self-management,” Scandinavian journal of caring sciences (32:2), pp. 961-970 (doi: 10.1111/scs.12534).

Price, M., and Anderson, P. 2007. “The role of presence in virtual reality exposure therapy,” Journal of Anxiety Disorders (21:5), pp. 742-751 (doi: 10.1016/j.janxdis.2006.11.002).

Riva, G., Molinari, E., and Vincelli, F. 2002. “Interaction and presence in the clinical relationship: Virtual reality (VR) as communicative medium between patient and therapist,” IEEE Transaction on Information Technology in Biomedicine (6:3), pp. 198-205 (doi: 10.1109/TITB.2002.802370).

Rosenberg, L., and Nygård, L. 2017. “Learning and knowing technology as lived experience in people with Alzheimer's disease: a phenomenological study,” Aging & mental health (21:12), pp. 1272-1279 (doi: 10.1080/13607863.2016.1222347).

Schultze, U. 2010. “Embodiment and presence in virtual worlds: a review,” Journal of Information Technology (25:4), pp. 434-449 (doi: 10.1057/jit.2010.25).

Skalski, P. 2011. “The Role of Presence in Healthcare Technology Applications,” in Advanced Computational Intelligence Paradigms in Healthcare 5: Intelligent Decision Support Systems, S. Brahnam and L. C. Jain (eds.), Berlin, Heidelberg: Springer Berlin Heidelberg, pp. 189-200.

Thommasen, H., Lavanchy, M., Connelly, I., Berkowitz, J., and Grzybowski, S. 2001. “Mental Health, Job Satisfaction and Intention to Relocate – Opinions of Physicians in Rural British Columbia,” Canadian family physician Médecin de famille canadien (47), pp. 737-744.

Viciana-Abad, R., Reyes-Lecuona, A., García-Berdones, C., and Díaz-Estrella, A. 2004. “A preliminary study of presence in virtual reality training simulation for medical emergencies,” Studies in health technology and informatics (98), pp. 394-396.

# 17 Collaboration of General Practitioners and Mobile Care

| | |
|---|---|
| Title | **Building Digital Bridges: Exploring the Digitized Collaboration of General Practitioners and Mobile Care in Rural Areas** |
| Number | **P11** |
| Authors | Caroline Reßing[1]<br>Marius Müller[1]<br>Michael Knop[1]<br>Henrik Freude[1]<br>Björn Niehaves[1]<br><br>[1]University of Siegen<br>Kohlbettstraße 15<br>57072 Siegen |
| Publication Type | Conference Proceedings |
| Publication Outlet | Americas Conference on Information Systems |
| Status | published |
| Full Citation | Reßing, C., Mueller, M., Knop, M., Freude, H., Niehaves, B. (2020), “Building Digital Bridges: Exploring the Digitized Collaboration of General Practitioners and Mobile Care in Rural Areas”, 26th Americas Conference on Information Systems (AMCIS 2020), Salt Lake City, USA. |

**Table 36: Publication Overview (P11)**

# Building Digital Bridges: Exploring the Digitized Collaboration of General Practitioners and Mobile Care in Rural Areas

*Abstract*: In the process of digitalization of healthcare, professionals, such as mobile care nurses or general practitioners, are facing both new challenges and opportunities. Digital technologies thereby promise to affect the cooperation of healthcare professionals on various levels, e.g., increasing quality of care, improving interprofessional communication, or optimizing economic aspects of care. Our study examines current issues of healthcare professionals concerning a digital change of care. We conducted qualitative interviews with primary care practitioners and providers of mobile care (nurses and care managers) to understand perceived obstacles in the process of digitalization and to formulate possible implications to encounter those obstacles. Our results suggest that insufficient communication and a lack of mutual trust have to be considered relevant issues. We therefore propose to focus future research on the interchangeability of different communication and documentation systems.

*Keywords*: Qualitative Study, Digitalization, General Practitioners, Mobile Care, Communication

## 17.1 Introduction

In times of demographic change and the lack of qualified healthcare workers, the healthcare system faces significant challenges that largely affect rural areas. The deficit in the number of practicing general practitioners (GPs) and the rising average age of the general practitioner population is one factor. Other factors, such as the rural exodus of GPs and the desire for flexible working models, exacerbate this problem (overtime, lack of successors). In rural areas, there are some environmental and infrastructural differences compared to urban regions. Both mobile care and general practitioners in rural areas are forced to travel long distances to visit a practice or patients and therefore have a geographical disadvantage (Currie et al. 2015). The existing shortage becomes particularly evident when looking at mobile care. The mobile care services in the countryside are already working above their limit, and additional nursing offers are missing. Part of the necessity for considering ambulatory healthcare is that, especially in rural areas, many elderly patients want or have to live at home, but this is not feasible without nursing services and home visits by their general practitioners. Hence, structures urgently need to be created to make the work more accessible and more efficient. Hence, in order to shed light on prevalent structures, processes, and occurring challenges, it is necessary to investigate how these two important actors work together. The interaction between GPs and mobile care is an essential part of working and patient-centered care.

Another part is how digital technologies can be used to address these issues. Technologies come with advantages and beneficial promises but also with challenges. Digitalization and innovative tools have a meaningful impact on different areas of life. Thus technological advances promise significant progress for patient treatment processes and healthcare in general. But there is a long way to go for digital health to reach this potential (Kreps 2014). The digitalization of rural medical care (which we define as professional treatment of patients and diseases) processes and the associated integration of innovative digital technologies are possible solutions to maintain and potentially improve population-wide care. The possibility of data transfer over long distances might help to affect the shortage of care related to spatial and temporal obstacles. Digital technologies also influence the relationship between health actors. In everyday life, technologies such as a smartphone and messengers are used for communication. However, this is not yet established in the healthcare sector and personal conversation is preferred in many cases, among others due to unsolved security aspects. Here, digital innovations can empower general practitioners and nurses to manage treatments and work processes more efficiently in the face of high demand. Especially in the care sector, efficiency requires nurses to deal with new technologies, like the use of smartphones (Wyatt and Krauskopf 2012). Healthcare professionals are confronted with a plethora of available technologies. It is difficult to assess, which are the essential factors in treatment (Jimison et al. 2008). First conducted studies have shown that this issue represents a significant challenge in rural healthcare (Warburton et al. 2014). A higher level of participation and advice from external sources for digitalization is needed (Niehaves and Plattfaut 2014).

Research lacks dedicated studies that investigate the interplay of general practitioners and mobile care and how collaborative processes can be digitally enhanced, facing prevalent challenges in comprehensive healthcare delivery. The paper at hand seeks to fill this research gap by investigating the cooperation of general practitioners and mobile care to bridge rural care deficits. It examines the attitudes towards digital technologies and how the view of mobile care is in contrast to that of general practitioners. Hence, the paper contributes to our understanding of the structures involving general practitioners and mobile care units in rural areas, occurring challenges and deficits, and how these issues can be digitally enhanced to achieve satisfactory and efficient processes. Our study is guided by the following research questions:

**RQ1:** *Which problems occur in the process of cooperation between nurses in mobile care and general practitioners in rural areas?*

**RQ2:** *How can digital technologies solve identified problems?*

## 17.2 Theoretical Background

### 17.2.1 The Challenges of General Practitioners and Mobile Care

Observations of the statistical figures in Germany show that the number of general practitioners in rural areas seems to be halved in the next few years. According to statistical data from the German Medical Association, the average age of GPs in Germany is 55.3 years and 15.1% have already reached retirement age (Munz 2018). As a result, they will retire in the next few years and will cause a decline in the comprehensive care supply. Rural areas lack the availability of short-term accessible healthcare services, among other things, due to inequitable urban-rural distribution, especially when looking at specialized general practitioners (Johnson, Brems, Warner and Roberts, 2006). These issues root in characteristics of rural areas such as low attractivity for young medical graduates opposed to urban areas (Rosenblatt and Hart, 2000; Yang, 2003), thus creating spatial disadvantages (Wilson et al., 2009). Patients often complain about difficulties in getting instant help in case of severe health issues that demand a specialist or intensive, ad-hoc care. In many cases, patients need to travel long distances to consult a specialist (Johnson et al., 2006; Currie et al., 2015). This development is increasingly forcing general practitioners and specialists to face the most significant challenges (e.g., shortage of specialists, rising patient numbers due to demographic change, or urban-rural disparities) in the health care system. Other key elements of the healthcare system, such as mobile and geriatric care, face very similar problems. Nevertheless, research lacks studies looking at digitization potentials and requirements within mobile care. Looking at the healthcare sector, it seems that the digitalization is far behind other sectors (Reddy and Sharma 2016). In 2017 DESTATIS published a report showing that there is a mismatch between patients and mobile care in

Germany (Destatis 2018). This calls for a scientific perspective on the role and potentials of digitalization for mobile care services.

However, in order to ensure comprehensive care in rural areas, the specifications of the rural area in Germany must also be considered. In rural areas, there are some environmental and infrastructural differences compared to larger cities. Mobile care and practitioners in rural areas are forced to travel long distances for a visit and therefore have a geographical disadvantage (Currie et al. 2015). In addition to the practitioners-care relationship, the acceptance of patients is also decisive with regard to the use of digital, mobile care. The advantages of structurally stronger regions, such as the quality of training and education (Yang 2003)or an improved work-life balance (Thommasen et al. 2001), encourage GPs to establish a business. As a result, inequalities in access to healthcare and in the health status of the population as a whole arise (Politzer et al. 2001). Interactions also play a role here, as the investigation of perspectives of GPs concerning the digitalization of treatments and the effects of patient empowerment showed that patient activity, the effects on the treatment process, patient differentiation and patient-practitioner interaction are relevant factors for the evaluation and willingness of practitioners to use health technologies (Mueller et al. 2020). Technologies can potentially bridge this disparity by providing virtual access to care and deploying digital ways to communicate. However, the necessary networks and infrastructures usually appear to be deficient in rural areas. This is the reason why solutions must be found urgently.

### 17.2.2 Digital Technologies in Healthcare

In the health sector, the efficient application of digital technology is a crucial issue and a growing challenge. The critical competency areas identified from a healthcare perspective concerning digitalization include knowledge of digital tools and their use required for excellent patient care, including the related social and communication skills (Konttila et al. 2019). Many studies have shown that there have been problems in communication on the part of the practitioner (Starfield et al. 1981; Stewart et al. 1979). Many of these studies focus on the practitioner-patient relationship (Levinson et al. 1993; Lu and Zhang 2019; Seiler et al. 2017). Misunderstandings in communication have a substantial impact on patient care (Sampson et al. 2016). Many digital technologies have been brought to the market, and the decision to use individual systems is often not easy for health professionals. Patients, in particular, want more digital communication, as there is a gap between patients' interest in online communication and what GPs can currently offer (Lee et al. 2016). In all these considerations, it is necessary to consider the views and needs of GPs and health care professionals. However, one study describes the use of smartphones by nurses in acute care. It showed potential for improvement in patient care, with the smartphone serving as a useful tool for communication between nurses and other health care actors (Farrell 2016). The concerns of digitalization among GPs are also reflected in other scientific studies. GPs were rather pessimistic about technology, especially concerning patient portals and expected changes that could negatively influence their workflows. An excellent example of how digital health can work is shown in Denmark. The country has developed a strategic plan for a coherent and trustworthy health network (e.g., by implementing a structured electronic voice platform), with the needs of patients at the forefront of the strategic plan (Mesko and Győrffy 2019).

## 17.3 Methods

### 17.3.1 Case Description and Study Design

We conducted a qualitative study within a regional governmental project dealing with the digitalization of care, its processes, and treatment paths. Due to its rural location, the involved city administration is particularly interested in improving medical care and in counteracting the future lack of personnel through digital structures. Through initial discussions with regional practitioners, it has become clear that poor communication between professional actors is a significant burden and could be improved with the help of digital structures. The communication problems in rural areas from the viewpoint of GPs comparison to the viewpoint of mobile care were examined within the framework of this study. We conducted semi-structured interviews to identify the main problems regarding communication and its digitalization, looking at each group of stakeholders (general practitioners and mobile care) individually and in comparison. Overall, the superordinate project earmarks to interview general practitioners, patients, nurses, and pharmacy staff to establish a holistic picture of the state of rural healthcare. We interviewed nurses and heads of care within two mobile care facilities. To do so, we engaged two expert groups applying a focus group workshop design. The first group involved two nurses and one head of care. The second group involved three nurses and a management employee. One reason for the focus group was that the executives of the respective institution wanted to be involved in the discussion. We have evaluated the target-oriented statements from both the nurses and the management. It is also clear that peoples' views complemented each other. We believe that many statements would not have been made without the group discussion.

### 17.3.2 Data Collection and Analysis

Overall, we conducted nine semi-structured interviews, including two workshops, with seven general practitioners and seven mobile care employees (five nurses and two managers). The average duration of the interviews amounted to 60 minutes (ranging from 50 to 80 minutes), and they were conducted on the respective institutional site. The interviewed GPs were aged between 41 to 66 years (52 years on average) and had a professional job experience between 15 to 35 years (25 years on average). The gender distribution was three females and four males. The participants from mobile care with an age of 35 to 64 years (49 years on average) and professional job experience between 17 to 32 years (22 years on average). The gender distribution was four females and three males. The used interview guideline was divided into five sections. The first section was devoted to personal questions, such as age and work experience. The second section was about previous general experiences with digital technologies and the status quo. Here, questions about previous experiences and information about digital solutions were important. In the third section, the communication paths across the different actors were explicitly queried. In the fourth section, the probands were presented a technical scenario in which a hypothetical procedure with a video conferencing system would be presented. In addition, the system can record and evaluate the patients' data using sensors and algorithms and gives, if it is a necessary treatment, a signal. Here, the acceptance and suitability for everyday use was questioned. In the fifth section, general questions were asked about individual desires regarding digitization and where the participants see themselves and their professional field in ten years. This paper focuses on digital technology and the improvement of the relationship between GPs and mobile care. The patient perspectives or those of other health actors are not in this paper. The interview guideline was not changed throughout the interviews. The actual data analysis was carried out after the last interview (ex-post data analysis). The interviews were conducted in German, audio-recorded, transcribed non-verbatim, and translated into English. To code the interview data, we used the software MAXQDA.

We followed a thematic approach for analysis, examining the data for common and recurring themes, ideas, and patterns of meaning (Boyatzis 1998; Braun and Clarke 2012). An inductive approach was chosen to allow the emergence of different themes and their iterative reflection with regard to the underlying empirical data. Our data analysis procedure consisted of six steps proposed by Braun and Clarke (2012): (1) We familiarized ourselves with the data by screening the transcripts and written notes taken during the interviews as well as listening to the audio recordings once more. (2) Next, we formed low-level, open codes and assigned them to the respective interview passages and statements. This led to the formulation of 19 codes in total. (3) In the third step, identified codes were merged into themes, while each theme addressed a common topic and meaning. (4) We reviewed the data again, looking for additional data supporting the identified themes and checking whether they hold their explanatory power with regard to the superordinate research questions. In doing so, we ensured that these themes contribute to our study in a significant way. (5) In step five, the final set of themes was defined. Additionally, we checked whether they, as a whole, depict a coherent illustration of our main findings that fit the paper and the overarching objectives. The data analysis yielded five main themes, namely Additional Expenditure, Use of Technologies, Communication, General Standard, and Trust. (6) The last step involved the act of writing down and correlating the findings in a comprehensive way, forming a compelling story (Braun and Clarke 2012). Table [37] provides coding examples contrasting the engaged sample groups.

| **Codes** | **Mobile care** | **General practitioners** |
|---|---|---|
| (Travel) Time | "*[...] time-consuming, if you are sitting in a general practitioners' office, [...] you are sitting in the waiting room for three-quarters of an hour, [...] that is wasted time, that is not paid*." | "*They report many things, but they are not that dramatic. Then you drive there, and it was, would have had also time for the next day*." |
| Pictorial Aid | "*[...], of some forms at the customer's, the system would already give away, [...], so new medication schedule is there, I scan with the mobile phone*." | "*[...] it would be a relief if you had a picture and not just the image of the person he is telling it to, but a real picture and then you say, ok, then I will come, I will look at it*." |

**Table 37: Coding Examples**

## 17.4 Findings

To preserve the anonymity of interviewees, we assigned a random number to each interview. The two mobile care groups are respectively numbered within nurses and management. The managers of mobile care are therefore crucial to the study, as they are usually the first chain link in terms of communication with the GPs and can provide insights into the problems for others than the nurses. Therefore, the results indicate whether the statement comes from the management or the nurses. However, since the problems of mobile care relating to GPs are considered in general, the propositions consider them as unit. Hence, the statements originate in a group discussion rather than an individual statement. Analyzing the results more closely, a frequency distribution of the statements across the two stakeholder groups can be observed. It is noticeable that the GPs see less problems in the communication with mobile care personnel than the other way around. We will use GP as an abbreviation for general practitioner and MN for mobile nurse and MM for mobile management respectively.

**Additional Expenditure:** This category represents a major issue for everyone involved. In literature, health expenditure is not a new phenomenon (Zhang, 2013). In most cases, it describes the economic factor of health technologies. In terms of numbers, it is the most frequently mentioned problem emerging from the interview data. The results indicate that overall, one of the main problems is the additional expenditure, but if you look at the statements of the general practitioners, it appears only as a time expenditure. The sixth GP interviewee claims to have no problems at all compared to outpatient care. The first GP interviewee claims that they have no problems with communication towards the nursing institutions. Sometimes they have some issue to clarify, but it could be resolved with a phone call: *"[...] there are some problems, but with a phone call [...] everything can be cleared up relatively quickly, so I do not see this big problem now*." (GP 1) One practitioner declaims that at times they would write down everything on paper and get the result per letter, and then they have to enter it into the PC. This would mean a considerable additional expenditure *"[...] write everything on paper [...] have to laboriously enter everything into the PC again for the next two days*" (GP6). In the interviews with nurses, it is criticized that the general practitioners caused an additional expenditure of time. However, it should also be noted that this is not always caused by a general practitioner, but in some cases, the medical assistants must also be held responsible for the increased waiting times. According to one MN interviewee, they often visit the general practitioners personally to pick up prescriptions. Alternatively, in some cases, they conduct initial talks with new patients in cooperation with the general practitioners. However, this does not always save time to talk in person: "*[...] time consuming, if you are sitting in a general practitioner's office [...] you sit in the waiting room for three-quarters of an hour, and that is wasted time that is not paid for*". (MN 2) It becomes apparent that mobile care employees see more problems and want to be relieved from the burden of managing processes GPs are (partly) responsible for. An additional problem, as described by MM, was that they have staff-related issues. As a metaphor, this deficit is described as a fight for personnel: "*It is about lacking personnel [...] we are under such pressure personnel-wise [...] very hard at the economic limit*" (MM 1).

**Use of Technology:** This category describes different perceptions of the behavior of general practitioners when using technology. As the conducted interviews suggest, the handling of innovative technologies can differentiate individually. MM states that there are two camps of GPs, the "modern" and the "medieval" one. An excellent example for this is the second statement from MM, in which they describe that not everyone has the capability to fax: "*I think we have the problem here on site that some general practitioners still live almost in the Middle Ages [...] Yes, the medieval camp and the modern age [...] Sometimes you cannot even send a fax because they do not have a fax machine*." (MM1) These are specific problems in this rural area, but they would also like to have technical support and would like to use it. For example, in order to save time, the institutions would like to be facilitated by pictorial aids. General practitioners also see relief in telemedicine. GPs, they hope that the telemedical solution will provide economic relief and time-savings. They would be able to make an initial diagnosis more easily via remote monitoring and treatment with the help of imaging techniques. In the case of a wound, it is better to have a look at pictures then only rely on descriptions of the wound by patients or nurses. In doing so, one would be able to notice whether there is a need for action more quickly, saving travel expenses, but also countless questions about the wounds and their treatment: "*It would really be a relief if you had a picture and not just one vividly described by the patient [...] will look at it*." (GP 2).

**Communication:** Communication is defined as "*Communication is transfer of information from one person to another, whether or not it elicits confidence. But the information transferred must be understandable to the receiver - G.G. Brown*" (Hans and Hans 2014). So, it is necessary to look into the ways of communication and how digital communication affects the relationship between GPs and mobile care staff. Our data suggests that the digital structures and communication channels in particular cannot be entirely separated from each other. However, not all problems should or will be solved by telemedicine. GP interviewee 4 said that it is sometimes necessary to speak in person. Frequently, further questions arise from the course of the conversation: "*[...] to discuss this frequently on-site, because sometimes questions arise that were not clear before. [...] you do not know everything on the phone beforehand*." (GP 4) The mobile care wishes for a network and a platform for sharing their work to be established: "*The networking: If I now imagine that there would be one unit page per customer, which everyone who works with him could access directly and see what the others were doing, that would make our work much easier*." MM 1 describes that their biggest problem is the communication within the practitioners and that they were not able to communicate properly: "*I think the biggest problem in this whole chain is the general practitioners [...] mostly problems with the medical practitioners because they are not able to communicate. No writing letters to the general practitioners, no giving information to any area*." (MM 1) Therefore, our data suggests that mobile care providers see differences in the role of communication between them and general practitioners. GP interviewee 6 describes that there are no communication issues towards the nurses at all: *"[...] As long as one speaks, there are no problems [...] that is a question of conversation [...] they do not understand each other [...]*." (GP 6) The last part of the statement reveals further issues. It describes that they all have to communicate and that the GPs see that nurses not always talk properly. The interviewee pronounces that it is only a question of conversational abilities.

**Standards:** The ISO (International Organization for Standardization) is a worldwide organization that develops standards for different branches, including the health sector. They pronounce that more than 1400 ISO health standards contribute to implementing health services, the exchange of information, aggregating data, and protecting an individual's privacy. However, with such a high number of standards, it is only understandable that the individual actors do not precisely know which standards exist and how to apply them. A GP interviewee declares that they are not aware of the standards followed by the MN sector. It seems that each institution sets its own set of standards: "*Because in principle, they are forced to have certain things clarified in the old people's home, [...] everyone has his own specifications*." (GP 1) A good example may be a statement from one of the MN focus groups. It shows that in this rural area, not all GPs are aware of the legal requirements. They pronounce that the GPs did not know that they have to get medical certifications. As an example, when a new patient be accommodated, they have to get a medical referral: "*Medical certificates, [...] every facility is required to provide a medical certificate [...] this caused a drama as if they have never seen these certificates here before*." (MN 3) One statement from a GP interviewee relates to the statement. They do not understand the necessity of a certificate: "*They need a certificate, which is also not standardized […] who is going to pay for it? We do the work there, but that is just for the formal […]*" (GP 5) For GPs, adhering to general standards appears to be very time-consuming in some cases. For example, one interviewee declares that they use different softwares and that they have no pre-defined grids to show and manipulate patient data. The information is not sorted, making it hard to identify the patient, their condition, and the history right away: "*We work with different grids […].*" (GP 7) In addition, information about patients and treatments are not getting merged and are formatted differently, leading to further confusion: "*It is quite critical that the nurse facilities have its drug lists. We have our list of medication, sometimes a general practitioner comes to the home and changes something – […] Then there are different lists, and then they always have to be compared.*" (GP 5) In relation to this issue, the MN participants also indicate that the used technologies, forms, and input masks lack standardization. Simultaneously, they expect the ongoing digitalization to introduce missing standards: "*[...] different programs and there is no uniformity […] someone should look first to create a reasonable basis for communication. […] if everyone had the same forms, this would work much better.*" (MN 1).

**Trust:** As our last category, the interviews suggest that trust is an essential factor affecting identified communication issues and the use of digitalization. At times, GPs may not deem the competence of nurses (or nurse assistants) adequate in specific situations, potentially alleviating trust in their assessments. The problem of lack of trust is twofold. The practitioners say that they do not know the nurses well and cannot assess their competencies, so they might not trust their statements in some cases. Furthermore, communication within the institutions does not work properly either, because the early shift and late shift do not communicate properly about whether there something unusual about the patients: "*[...] you have early, late, and night duty, you have often three nurses, and you have three different information regarding a problem.*" (GP 3) and "*[...] on the one hand, they are not my direct employees, and I do not know how I can rely on them, but also sometimes the knowledge simply is not there.*" (GP 2) Alternatively, the second MN group mentioned that they sometimes could not trust the GPs to show up as they promised, they have no influence on what the practitioners do with the redirected information. "*[...] what the partner does with it in the relationship, I can no longer influence.*" (MM 2).

### 17.5 Discussion

Based on the findings, we can formulate five propositions. These propositions inform about the relationship between practitioners and mobile care and the use of health technologies in care. In the following we explain the proposals and give implications for research and practice.

> **Proposition 1:** Mobile care places a high value on the possibility of having a personal conversation with general practitioners. They see a greater need for communication than the general practitioners do.

This statement makes clear that communication is an important part of regular care. Instead of digitizing the processes in general, there is a desire for personal conversation. Nevertheless individual communication channels are desired. These would be particularly helpful in case of queries regarding treatment or prescriptions. Mobile care therefore considers it useful to have a faster communication channel to the GPs than to the patients themselves. Through digital progress and the use of a tablet, smartphone, or sensor technology, they could envision more straightforward communication channels. From a technical point of view, this proposal calls in particular for ways to facilitate rapid contact with the general practitioners or specialists. Digital tools, such as a platform to share and access patient data, can thus invoke the feeling of faster availability. The quality of this interprofessional communication can be improved by empathy and adaptation to individual needs (Abrahamsson et al. 2015).

> **Proposition 2:** The additional effort could be eliminated with more digital support systems

As our results show, the participants want technologies that can bridge distances and thus increase the availability and accessibility of needed expertise. Nurses would welcome the use of technologies that allow independent access to a general practitioner. The use of telemedicine could reduce both long travel and waiting times. From a technological point of view, it makes no difference whether the digital support systems are used by the patient or by the mobile care providers on site, so the general practitioner would also benefit from integrating the option for patients to provide data by using the system. Especially imaging techniques and the possibility to transfer images, e.g. for the first anamnesis or diagnosis, are desired. The obligation to travel to the general practitioner's practice could also be reduced for patients that are taken care of at home. One remaining problem that technical progress is not able to fully solve, yet, is the lack of qualified personnel. However, attempts can be made to create new structures to create a productive and flexible workplace, which incorporates innovative digital tools and potentially increases job attractiveness. As studies from other sectors show, digitisation can drive productivity and employment growth and is therefore an economic factor (Evangelista et al. 2014).

> **Proposition 3:** Mobile care is more likely to use digital technologies than general practitioners.

This proposition is initially based on the statements of mobile care. They declare that there is a very high variance amongst GPs with regard to attitudes towards an actual use of technologies. According to the interviews it seems that some GPs have fallen behind in the use of modern technologies. Some of them would not even use a fax machine, which is a common way of exchanging information (e.g. medication plans or referrals). In addition, a general practitioner complained about how long it takes to write things down on a computer and that handwriting the diagnosis would be much faster. We could observe this development towards the apparent additional effort through digitalisation primarily in the statements to and from the GPs. Mobile care, on the other hand, is already using intelligent technologies to communicate with each other (Farrell 2016). One way to explain this is the age-gap. According to the interviewees, the average age of executing care employees is lower. Thus, they represent a generation that grows up using modern technologies. Nevertheless, the use of technologies is desirable for both sides and greatly relies on proper guidance and facilitating factors. In the background, as an inhibiting mechanism in the use of technologies, data protection plays a major role in the medical sector. Practitioners are worried about sensitive patient data falling into the wrong hands if they share it with others. However, since technology in a care scenario requires the disclosure of patient data, research suggests that a high level of trust can compensate for even a low level of privacy. It is essential to control the access to data through manageable lists of authorized persons and institutions (Benaloh et al. 2009). Technological innovations will continue to change healthcare, such as new medicines and treatments, new devices, and social media. Yet, human factors such as individual adoption and use behavior will remain one of the forefront limiting factors of breakthroughs in digitized care (Thimbleby 2013).

> **Proposition 4:** So far there are only a few standards in the standard care in the area of digitalization or communication, which can be used by both (GP and MN).

In the investigated region in Germany there seem to be few uniform standards in the direction of digitization, which are also followed by the actors. Actually, ISO standards have been established by the KVBs (International Organisation for Standardization 2019). However, these standards also reduce the billing in order to guarantee financing and billing to the health insurance companies. In the area of software or hardware use, everyone uses the systems that suit him best. Therefore there are no uniform health information systems or interfaces in the region that could be used to facilitate communication and to transform data easily. There are also no standards for documents such as medication plans. The use and maintenance of the uniform medication plan, especially in mobile care, would be helpful to create standards, but to our knowledge they are not being adhered to. The documentation has not yet arrived completely in electronic form in the healthcare system. And therefore a standardized documentation of reports is often difficult. Many actors, including practitioners and care services, give priority to what is best for their own business. Other actors often seem to play a secondary role in deciding which health information system and protocols to use, which prevents beneficial cooperation.

> **Proposition 5:** The trust in each other relates to occurring communication issues. General practitioners' trust in nurses and vice versa is an essential factor that precedes the beneficial use of technology.

The identification of trust as a promoter for technology use by GP and MN allows for several new approaches. For instance, one trust-generating factor emerging from the interviews is the knowledge of the employees. When the GPs do not know the nurses, trust in their opinions is initially low. Here, for instance, one important factor is confidence. Confidence is required for active engagement in interprofessional collaboration (Pfaff et al. 2014). In Germany, oftentimes GPs are bestowed a more prestigious status compared to nurses. Even in the interviews, the nurses assign a high social status to practitioners. Therefore, it is perceived by nurses to be difficult to engage with practitioners at eye level, especially in case of conflicting opinions. In addition, to overcome communication issues, digital technologies could also create more trust in nurses' work. For instance, pre-recorded pictures and messages (e.g., medication advice or pictorial representation of wound care) can create trustful and intimate settings without having to patch in a practitioner. Since the trust relation of general practitioners and care is essential for good healthcare, it is necessary for them to have a good relationship.

## 17.6 Conclusion and Outlook

Following RQ1 ("Which problems occur in the process of cooperation between nurses in mobile care and general practitioners in rural areas?"), the predominant factors that constitute the relationship seem to be communication and trust. The interviews made it clear that communication is often not very efficient. All actors involved (general practitioners, mobile care) are equally affected. Uniform documents and standards could help to minimize bureaucratic efforts and misunderstandings. Separate telephone numbers and platforms for communication between healthcare providers could also be helpful to enable them to contact each other more quickly. Hence, digital technologies should foster efficient and mutual communication and thus improve cooperation, which currently seems somewhat awkward. Cooperation also relates to the perceived social status of practitioners. The supposedly higher status of the practitioners makes it more complicated, and responsibility is rarely transferred. To answer RQ2 ("How can digital technologies solve identified problems?"), this study shows that mobile care and general practitioners have recognized the trend and partial necessity to incorporate new technologies into their practices. The desire for digital structures within communication (e.g., through telemedical solutions) has become apparent. As our data indicates, a lot of the issues (economic factors like time, or personal factors like trust) could be solved by a digital communication platform, a telemedical concept, or text message-based interventions (Mahmud et al. 2010). It becomes apparent, that the issue of providing a functioning digital infrastructure (e.g., internet access and speed) in rural and remote areas still needs to be addressed and represents a prerequisite to testing and evaluating digital technologies in active care. The study also shows that there is an interest in improving healthcare in areas with a (future) lacking supply of patient care services. The study reveals many gaps that oblige different actors to work together. However, many general practitioners in the given area deem their timely involvement in digitization unrealistic. It remains an open question whether this is a problem due to age structure within the healthcare system, calling for further investigations.

Our study is subject to some limitations. First, we are aware of the difficulties that can arise during focus group sessions, such as conformity through dominant opinions, idiosyncratic statements, or the low level of generalizability (Stewart and Shamdasani 2015). Besides, an mobile care executive was present during the discussions, which may have prevented honest criticism by the employees due to power relations. Second, we have examined rather small and homogeneous samples, which further limits the generalizability of our study. Further studies with a higher outreach are helpful to bridge the limitation that arises from the participants coming from a single region. Further studies can aim for testing our findings engaging a more significant number of participants through quantitative methods (e.g., online surveys). Third, incorporating theoretical concepts and insights from other disciplines (e.g., care research) as well as cultural factors into the data analysis could yield further results. Therefore, our study opens up many successive future research opportunities. For elderly people, functioning and patient-centered cooperation between nurses and general practitioners is crucial. One important complementary research activity involves future studies that incorporate other players involved, e.g. stationary care, pharmacies, and clinics. Shedding light on the way these actors work together allows for establishing a more holistic model of communication structures, associated issues and barriers, as well as potentials for digital tools as an optimizing measure.

## 17.7 References

Abrahamsson, B., Berg, M.-L. U., Jutengren, G., and Jonsson, A. 2015. "To recommend the local primary health-care centre or not: what importance do patients attach to initial contact quality, staff continuity and responsive staff encounters?" International journal for quality in health care : journal of the International Society for Quality in Health Care (27:3), pp. 196-200.

Benaloh, J., Chase, M., Horvitz, E., and Lauter, K. 2009. "Patient controlled encryption," in Proceedings of the 2009 ACM workshop on Cloud computing security - CCSW '09, R. Sion and D. Song (eds.), Chicago, Illinois, USA. 13.11.2009 - 13.11.2009, New York, New York, USA: ACM Press, p. 103.

Boyatzis, R. E. 1998. Transforming qualitative information: Thematic analysis and code development, SAGE.

Braun, V., and Clarke, V. 2012. "Thematic analysis," 14338100.

Currie, M., Philip, L. J., and Roberts, A. 2015. "Attitudes towards the use and acceptance of eHealth technologies: a case study of older adults living with chronic pain and implications for rural healthcare," BMC Health Services Research (15:1), p. 162.

Destatis 2018. Pflegestatistik: Pflege im Rahmen der Pflegeversicherung Ländervergleich - Ambulante Pflegedienste.

Evangelista, R., Guerrieri, P., and Meliciani, V. 2014. "The economic impact of digital technologies in Europe," Economics of Innovation and New Technology (23:8), pp. 802-824.

Farrell, M. 2016. "Use of iPhones by Nurses in an Acute Care Setting to Improve Communication and Decision-Making Processes: Qualitative Analysis of Nurses' Perspectives on iPhone Use," JMIR mHealth and uHealth (4:2), e43.

Hans, A., and Hans, E. 2014. "Role of Professional Communication in To," Journal of Research in Humanities and Social Science (Volume 2 Issue 9), pp. 72-76.

International Organisation for Standardization 2019. ISO and Health: Great things happen when the world agrees. Accessed 29 November 2019.

Jimison, H., Gorman, P., Woods, S., Nygren, P., Walker, M., Norris, S., and Hersh, W. 2008. “Barriers and drivers of health information technology use for the elderly, chronically ill, and underserved,” Evidence report/technology assessment (175), pp. 1-1422.

Konttila, J., Siira, H., Kyngäs, H., Lahtinen, M., Elo, S., Kääriäinen, M., Kaakinen, P., Oikarinen, A., Yamakawa, M., Fukui, S., Utsumi, M., Higami, Y., Higuchi, A., and Mikkonen, K. 2019. “Healthcare professionals' competence in digitalisation: A systematic review,” Journal of clinical nursing (28:5-6), pp. 745-761.

Kreps, G. L. 2014. “Achieving the promise of digital health information systems,” Journal of public health research (3:3), p. 471.

Lee, J. L., Choudhry, N. K., Wu, A. W., Matlin, O. S., Brennan, T. A., and Shrank, W. H. 2016. “Patient Use of Email, Facebook, and Physician Websites to Communicate with Physicians: A National Online Survey of Retail Pharmacy Users,” Journal of general internal medicine (31:1), pp. 45-51.

Levinson, W., Stiles, W. B., Inui, T. S., and Engle, R. 1993. “Physician Frustration in Communicating with Patients,” Medical Care (31:4), pp. 285-295.

Lu, X., and Zhang, R. 2019. “Impact of Physician-Patient Communication in Online Health Communities on Patient Compliance: Cross-Sectional Questionnaire Study,” Journal of medical Internet research (21:5), e12891.

Mahmud, N., Rodriguez, J., and Nesbit, J. 2010. “A text message-based intervention to bridge the healthcare communication gap in the rural developing world,” Technology and health care : official journal of the European Society for Engineering and Medicine (18:2), pp. 137-144.

Mesko, B., and Győrffy, Z. 2019. “The Rise of the Empowered Physician in the Digital Health Era: Viewpoint,” Journal of medical Internet research (21:3), e12490.

Mueller, M., Knop, M., Reßing, C., Freude, H., Oschinsky, F., Klein, H. C., and Niehaves, B. 2020. “Constituting Factors of a Digitally Influenced Relationship between Patients and Primary Care Physicians in Rural Areas,” 53rd Hawaii International Conference on System Sciences (HICSS-53), USA, Hawaii. (ed.).

Munz, H. (K.) 2018. “Statistical Information from the Federal Register of Physicians: Federal Territory,” Niehaves, B., and Plattfaut, R. 2014. “Internet adoption by the elderly: employing IS technology acceptance theories for understanding the age-related digital divide,” European Journal of Information Systems (23:6), pp. 708-726.

Pfaff, K. A., Baxter, P. E., Jack, S. M., and Ploeg, J. 2014. “Exploring new graduate nurse confidence in interprofessional collaboration: a mixed methods study,” International journal of nursing studies (51:8), pp. 1142-1152.

Politzer, R. M., Yoon, J., Shi, L., Hughes, R. G., Regan, J., and Gaston, M. H. 2001. “Inequality in America: the contribution of health centers in reducing and eliminating disparities in access to care,” Medical care research and review : MCRR (58:2), pp. 234-248 (doi: 10.1177/107755870105800205).

Reddy, P., and Sharma, B. (eds.) 2016. Dititalisation: The Future of Health Care, Journal of Business Management.

Sampson, R., Barbour, R., and Wilson, P. 2016. “The relationship between GPs and hospital consultants and the implications for patient care: a qualitative study,” BMC family practice (17), p. 45.

Seiler, A., Knee, A., Shaaban, R., Bryson, C., Paadam, J., Harvey, R., Igarashi, S., LaChance, C., Benjamin, E., and Lagu, T. 2017. “Physician communication coaching effects on patient experience,” PloS one (12:7), e0180294.

Starfield, B., Wray, C., Hess, K., Gross, R., Birk, P. S., and D'Lugoff, B. C. 1981. “The influence of patient-practitioner agreement on outcome of care,” American journal of public health (71:2), pp. 127-131.

Stewart, D. W., and Shamdasani, P. N. 2015. Focus groups: Theory and practice, Thousand Oaks, California: SAGE.

Stewart, M. A., McWhinney, I. R., and Buck, C. W. 1979. “The doctor/patient relationship and its effect upon outcome,” Journal of the Royal College of General Practitioners (29), pp. 77-82.

Thimbleby, H. 2013. “Technology and the future of healthcare,” Journal of public health research (2:3), e28.

Thommasen, H. V., Lavanchy, M., Connelly, I., Berkowitz, J., and Grzybowski, S. 2001. “Mental health, job satisfaction, and intention to relocate. Opinions of physicians in rural British Columbia,” Canadian Family Physician (47:4), pp. 737-744.

Warburton, J., Cowan, S., Winterton, R., and Hodgkins, S. 2014. “Building Social Inclusion for Rural Older People Using Information and Communication Technologies: Perspectives of Rural Practitioners,” Australian Social Work (67:4), pp. 479-494.

Wyatt, T. H., and Krauskopf, P. B. 2012. “E-health and Nursing: Using smartphones to enhance nursing practice,” Online Journal of Nursing Informatics (16).

Yang, J. 2003. “Potential urban-to-rural physician migration: the limited role of financial incentives,” Canadian Journal of Rural Medicine (8:2), p. 101.

# 18 Patient Responsibilities in Telemedicine Use

| | |
|---|---|
| Title | **Exploring Emerging Patient Responsibilities in Telemedicine Use: An Empirical Study** |
| Number | **P12** |
| Authors | Marius Müller[1]<br><br>[1]University of Siegen<br>Kohlbettstraße 15<br>57072 Siegen |
| Publication Type | Conference Proceedings |
| Publication Outlet | New Perspectives on Digitalization: Local Issues and Global Impact |
| Status | published |
| Full Citation | Mueller, M. (2020), “Exploring Emerging Patient Responsibilities in Telemedicine Use: An Empirical Study”, In Radtke, J., Klesel, M., Niehaves, B. (Eds.): New Perspectives on Digitalization: Local Issues and Global Impact. Proceedings on Digitalization at the Institute for Advanced Study of the University of Siegen, Siegen, Germany. |

**Table 38: Publication Overview (P12)**

# Exploring Emerging Patient Responsibilities in Telemedicine Use: An Empirical Study

*Abstract*: Telemedical solutions are increasingly utilized by physicians to cope with emerging challenges in modern healthcare. Rising numbers of patients due to demographic change and associated health issues complicate the comprehensive provision of care. Digital technologies, such as video consultation tools that establish a virtual connection between patients and practitioners, are able to antagonize these issues to some extent. However, the digitalization of care processes affects patients as well, who are increasingly obliged to be an active part of healthcare by using telemedicine and assessing its applicability and functionality. As a result, patients become more and more responsible for an effective and successful implementation of telemedicine. In that vein, this study proposes preliminary empirical findings and discussion points drawn from an ongoing research project. Findings suggest that responsibilities emerge regarding the preparation of online appointments, decision-making, the perpetuation of behavioral patterns, and the prevention of overuse.

*Keywords*: Telemedicine, Qualitative Study, Patient Responsibilities, Primary Care, Healthcare Technologies

## 18.1 Introduction and Background

The health domain faces great challenges that exert increasing pressure on existing structures and providers. For instance, the continuous demographic change and associated, age-related health issues are responsible for increasing patient numbers in need of care (Demiris & Hensel, 2008). Simultaneously, a decline in care availability and the emergence of an inequitable distribution of healthcare services takes place (Wilson et al., 2009), inter alia due to decreasing numbers of professionals, especially in rural areas (Mueller et al., 2020). As a reaction to these issues throughout the last two decades, an ongoing trend towards the digitalization of healthcare is noticeable. A variety of digital approaches and tools are under constant development and already in use. For instance, a wide spread technology in relation to others is the live video consultation (Kvedar et al., 2014). Further, sensory equipment can be used to measure vital signs of patients, which can be utilized by practitioners (Pantelopoulos & Bourbakis, 2010).

Online databases and platforms allow patients to proactively seek information on health issues and treatments online (Ahmad et al., 2006). As a result, digital technologies promise benefits for effective and satisfying treatments, a comprehensive supply of care, an increase in availability and quality of care services, and the release of provider-sided resources by making higher patient numbers more manageable.

Since treatments and therapies are mutual processes by nature (Hojat et al., 2010), involving healthcare consumers and providers as well, the introduction of digital tools and procedures increases the responsibility on both sides to cope with emerging necessities and challenges (Mueller et al., 2020). Digital technologies further promote deliberate treatments that can be triggered and partially controlled by patients as well (Castro et al., 2016). A shift from a more passive to a more active patient role can be detected (Osei-Frimpong et al., 2018). With the rise of digital technologies within therapeutic settings, patients are increasingly in charge to actively use modern tools, provide vital parameters and information, acquire the needed competencies for appropriate and effective use, and be aware of their own health and potential measures (Van Woerkum, 2003), hence increase their health literacy. Health literacy can be defined as "[…] the ability to understand and interpret the meaning of health information in written, spoken or digital form" (Adams et al., 2009, p. 144). The concept involves individual knowledge on both health and adequate treatment, as well as the required skills to plan and act appropriately (Nutbeam, 2008). It appears to be an important factor when it comes to adequately and comprehensively assess, understand, and communicate one's own condition (Kreps, 2017; Mueller et al., 2019), which can be reinforced by digital technologies (Kayser et al., 2015).

Digital technologies, as can be seen in many other sectors (e.g., Mäkinen, 2006), lower the threshold for partaking in dispersed processes. Hence, new habits and behavioral patterns are formed by patients regarding the consumption of care, the execution of therapeutic measures, and the consultation of physicians (Mueller et al., 2020). Simultaneously, patients become responsible for making decision and behaving in a way that aligns with the structures and processes prevalent in healthcare. For instance, overconsumption of digital offers can increase provider-sided workloads, whereas the neglection of those can render digitalization efforts unprofitable and cumbersome to implement and maintain.

This study seeks to expand our understanding of what kind of responsibilities emerge for patients playing an active role in digitalized care. To date, only little research has been done looking at the way patients can handle the increasing amount of telemedical offers in a responsible, beneficial, yet satisfying way. Hence, the objective of this research-in-progress paper, being part of a superordinate project, is to provide first empirical insights on the responsibilities of patients in telemedicine use. Hence, this study is guided by the following research question (RQ):

**RQ:** *What kind of patient responsibilities emerge from the incorporation of telemedicine tools within primary care treatment processes?*

The paper presents preliminary findings drawn from semi-structured interviews, which have been conducted engaging five users of telemedicine. The findings suggest several tasks, attitudes, and behaviors patients perceive and attach importance to regarding the use of a video consultation system. As a contribution, this paper further enables the implementation and utilization of telemedicine within primary care processes that incorporate the patient as an active, responsible, and self-aware actor.

## 18.2 Methods

### 18.2.1 Case Description

This paper is part of a larger research agenda within a regional project on the digitalization of rural primary care processes and treatments. The project is intended to strengthen the understanding of how patients and physicians perceive, evaluate, intend to use, and actually use telemedicine for primary care treatments. Amongst other approaches and innovations, the utilization of online video consultation tools is treated as a feasible and beneficial measure to cope with increasing patient numbers and declining prevalence of healthcare professionals and graduates practicing in rural areas. As a prerequisite of digitally supported healthcare, the user acceptance of such technologies needs to be further elaborated. Here, this study positions itself in order to build an empirical baseline and achieve deeper insights on user attitudes and behavior.

### 18.2.2 Data Collection and Analysis

As a part of the overarching project, we conducted an initial set of five interviews engaging patients that have already encountered telemedicine in their treatments. The interviews took between 19 to 30 minutes (25 minutes on average) and were conducted by the author on a participating physician's practice site. Following a convenient sampling approach, the physician reached out to patients that have already used the video consultation system and were willing to participate in the study. The sample consisted of 1 female and 4 male participants aged between 35 and 52 years (42 years on average), whereof 3 showed non-chronic symptoms and 2 were patients with chronic diseases. They had used telemedicine between one and two times. The participants were briefed and signed an informed consent before each interview started, which clarified the data acquisition and analysis process, the voluntariness of partaking in the study, and their right to withdraw their participation. The interview guideline included questions on various factors underlying the use of and attitudes towards telemedicine. Here, the classification by Or and Karsh (2009) was adapted to our context, comprising patient, social, environmental, organisational, and technical factors. The guideline remained unchanged across all interviews. The interviews were audio recorded, transcribed non-verbatim, and translated from German into English for the purpose of analysis and reporting.

For preliminary data analysis in the light of the superordinate research question, we followed an approach comprising open, axial, and selective coding (Strauss & Corbin, 1998). While open coding seeks to assign labels to interview statements and passages, axial coding aims for subsuming labels under common categories. Finally, selective codes are identified that represent the major theoretical underpinnings of the data, containing and describing all axial codes. For instance, the interview statement "In principle, I use it the same way as I did before, or rather in the same frequency, so I do not go to the doctor more or less often." is openly coded as 'consultation of physician as usual', subsumed under the axial code 'moderate and conscious use', finally leading to 'behavioral patterns' as the selective code. In this preliminary stage, the data analysis used for this study is done by only one researcher. In upcoming studies, analyses are performed dyadicly to increase reliability and detect a broader spectrum of phenomena.

## 18.3 Interim Findings

The interim findings encompass four important categories that describe emerging patient responsibilities in telemedicine care, which are (1) preliminary considerations, (2) decision making, (3) behavioral patterns, and (4) overuse. As a supplementary finding, the benefits of telemedicine perceived by the participants are reported to describe positive reactions to using a video consultation tool. To preserve the interviewees' anonymity and prevent the delineation of interviews by their order, the numbers assigned to interviews have been randomized (Mueller & Heger, 2018).

### 18.3.1 Perceived Benefits

As literature and the collected empirical data show, the application of telemedicine such as video consultation tools within primary care processes and treatments come with meaningful benefits. In the perception of the study participants, the possibility to contact their general practitioner in a spatially independent way is of major value, being an efficient and pleasant way to get treatment:

> “*And in case of simple things, like discussing blood values, you only want to know how they are, are they okay [...] I’m saving a lot of time, because I am not sitting here [the practice], and for him [the physician] too, in that time he can do other things. I find it very effective*.” (Interview 5)
>
> “*Consulting the doctor through the video consultation is simply easier for me because it is more pleasant, faster, I am more flexible [...] Because otherwise you had to be here a quarter before your appointment, then you have three people ahead of you, then you wait half an hour. So you have an [video consultation] appointment at ten o'clock, it is finished in ten minutes and everyone is happy*.” (Interview 3)

In addition, using telemedicine for physician consultation is oftentimes favored over visiting the practice personally due to, for instance, shorter waiting times or avoiding a potential contagion:

> “*It is also more comfortable to sit at home than in a waiting room, where many others with some kind of disease are waiting, because the risk of infection is not quite so high when you sit at home and wait*.” (Interview 2)
>
> “*So if that was offered to me, I think I would always prefer the video consultation. Unless I really have physical complaints, or something visible where I would say, the doctor must have a look at it*.” (Interview 2)
>
> “*I am here regularly and I didn't feel like always sitting in the waiting room, and then [the video consultation] was offered to me and I jumped on the offer relatively quickly*.” (Interview 3)

Apparently, as our preliminary findings show, telemedicine can lead to high use intentions and actual use by patients that are seeking the aforementioned benefits and convenience. However, since digital offers such as video consultations lower the bar for contacting a general practitioner and ease the access to treatments, patients become increasingly obliged to think about the necessity, quantity, and extent of seizing the virtual alternatives. In this regard, the data suggests several patient responsibilities when it comes to actually using telemedicine for physician consultation.

### 18.3.2 Preliminary Considerations

One responsibility mentioned by the participants relates to considerations patients should engage in before consulting the physician via a digital tool or even making a respective appointment. In this regard, the interviews suggest that patients should carefully assess their health status, potential issues, and proper ways of dealing with them. Not every health issue is suited for telemedical treatment, since it requires, for instance, a physical meeting and examination. Here, the patient seems to become more and more responsible for the feasibility and, thus, the outcome of the consultation, obliging them to prepare each session by themselves:

> "*[You do not] address topics that you cannot actually discuss during the video consultation. [...] you should bring along preparations, even as a patient, so that you do not address anything where the doctor tells you 'well, let us end this here, because you still have to come by'.*" (Interview 4).

Further, one participant mentioned that certain checks and assessments can be done independently and self-sufficiently:

> "*Before I drop by here [the practice], I check a few things anyway. And if everything I checked is fine and I have not found a solution yet, then I will come here*." (Interview 2)

This, in turn, requires patients to have fairly high degrees of health literacy as well as self-efficacy when it comes to fathoming what treatment suits them best.

### 18.3.3 Decision Making

Being closely linked to the preliminary considerations, patients are invoked to sculpt their decision making process accordingly. Weighing off given possible treatments, including those supported by telemedicine, can lead to several outcomes that help the patients to behave in a certain way, hence making a decision. As the data suggests, the participants are inclined to waive using telemedicine in the first place given the situation:

> "*I would not even arrange such a video consultation appointment, but come here [the practice] directly for consultation*." (Interview 4)
>
> "*But in the future I must always distinguish between what I have and what I want, and then I can decide for myself whether to do it via video conference or in person. However, you have to think about it yourself [...]*." (Interview 5)

One participant mentioned the need for judging the situation in an autonomous way and exhibiting a certain degree of self-discipline:

> "*I think that somewhat depends on the patient himself. How do I judge that myself? Do I have to go there [the practice] now? Is it serious? Of course, a certain self-discipline is necessary*." (Interview 5)

Apparently, the presence of telemedical offers calls for an increase in individual competencies that enable patients to make appropriate decisions without risking their health.

### 18.3.4 Behavioral Patterns

As some of the interviewees mentioned, the sole possibility to consult a physician online does not necessarily lead to new behavioral patterns regarding the frequency and reasoning of appointments. The data suggests, that although telemedicine facilitates easy and low threshold access to a desired treatment, patients tend to behave the same way as they did before:

> "*In principle, I use it the same way as I did before, or rather in the same frequency, so I do not go to the doctor more or less often*." (Interview 3)
>
> "*Actually, only when I really have an issue. Yes, sure, one should do preventive medical checkups, but actually [I consult the doctor] as usual in the end*." (Interview 1)
>
> "*The question is how I deal with it myself. I handle it the way I have handled it so far, when I think I have to go to the doctor, due to a cold or whatever, I use this tool*." (Interview 5)

Patients behaving this way put less stress on physicians and the healthcare system overall. Thus, telemedicine is clearly seen as a valuable supplement and, in some cases, substitute for visiting the practice, as long as the patients' consumer behavior remains unchanged.

### 18.3.5 Overuse

However, while telemedicine lowers the threshold for physician consultation and, thus, consumption of health services, the risk of overuse emerges:

> "*Yes, if [telemedicine] is totally accepted [by patients], it is like everywhere else, there could also be an overuse. But probably not by everyone, but this could of course also lead to it, because it makes it actually easier to contact [the doctor].*" (Interview 5)
>
> "*When everyone sees how easy it is to use, it can of course also go the other way around, that I use it more often, compared to when I go to the doctor.*" (Interviewee 5)

As our data suggests, patients are aware of potential impacts that solutions such as video consultation systems can have on capacities of physicians. One interviewee refers to common sense when using telemedicine for treatments:

> "*I could imagine that this could be exploited. I could say, in case I need a yellow note [attesting one's inability to work], due to partying a little bit more on the weekend than usual […] So if I am at the doctor's regularly and he knows me, he already knows how to deal with it. But as I said, I also know that you should not switch off your common sense. I know when I can get an online appointment and when not.*" (Interview 3)

It is also stated, that physicians might be able to detect unjustified online consultations, which takes away some portion of responsibility from the patient. However, patients tend to be aware of negative consequences the overuse of telemedicine might have, such as high effort for physicians to cope with increased availments.

## 18.4 Preliminary Discussion

The findings suggest, that patients do hold a share of responsibilities when it comes to making telemedicine work in healthcare. Apparently, patients are obliged to step into an active role and contribute to the success of digital tools such as the video consultation by adapting their use behavior. A shift from pure consumption to a form of co-creation can be detected (Osei-

Frimpong et al., 2018). In order to achieve a satisfying and effective digital experience, patients increasingly need to be aware of their health issues, potential and feasible measures, and the applicability and bounds of technology. To further discuss the interim findings, two initial propositions are presented in the following. Propositions represent an entrenched way to depict theoretical outputs and infuse future research (Baxter & Jack, 2008). The first proposition covers the findings regarding preliminary considerations patients should encounter before making a telemedical appointment. With the rise of the video consultation being introduced by increasing numbers of primary care physicians, its feasibility and applicability to address the patient's health issue(s) should be incorporated into decision making processes:

> **Proposition 1:** In order to increase the effectiveness of telemedicine, patients should upfront assess the feasibility of using digital tools for treatment.

It becomes clear, that the patient's health literacy as well as self-efficacy regarding technology use and evaluation play important roles. Health literacy refers to an individual's knowledge about health, prevalent or emerging issues, and possible treatments, as well as the competence to process it and act accordingly (Adams et al., 2009; Nutbeam, 2008). Hence, as a prerequisite for an effective implementation and continous use of telemedicine, higher levels of individual health literacy must be achieved. Besides, once a patient is able to fathom necessities and possibilities of a digital treatment, the capability to use telemedicine properly is vital. Here, the concept of computer self-efficacy is important (Compeau & Higgins, 1995). Patients need to be able to use respective technologies in an effective and confident way. With regard to technology design, patients should be asked to provide information on their symptoms beforehand, while providing them informational support to accomplish this. The second proposition refers to the behavior patients should display in order to keep the amount of effort associated with operating telemedical solutions low and avoid overuse:

> **Proposition 2:** Patients should maintain behavioral patterns with regard to using telemedicine for physician consultation to prevent overuse and minimize efforts associated with its operation.

Deploying telemedicine within former analogous processes and operating it effectively comes with great efforts for physicians (Mueller et al., 2020). However, since tools such as the video consultation enable a low threshold and easy way to contact practitioners, patients might neglect those efforts since they take the technology for granted due to its high dissemination in other areas of life. A potential tendency towards a disproportionately frequented use emerges, which calls for a moderate, considerate, and goal-oriented use of telemedicine and associated levels of behavioral control (Ajzen & Madden, 1986). Respective behavioral patterns need to be formed and promoted in order to facilitate the digital transformation of primary care procedures. On a design level of telemedical tools, the implementation of ways to assess the necessity of online treatment in relation to the amount of previous sessions and outcomes seems feasible.

### 18.5 Conclusion and Future Research

This paper proposes preliminary findings and propositions empirically drawn from an ongoing research agenda. With regard to the RQ, the findings suggest that a variety of patient responsibilities arise from the implementation of telemedicine within treatment processes, such as preparations and respective decisions patients should make upfront an appointment to ensure treatment effectiveness. The paper contributes to our understanding of the way patients perceive and use digital offers within care and opens up a wide space for further research. The paper exhibits some limitations, such as the small sample size and the low generalizability. For the time being, the study does not consider sample characteristics, such as varying health issues and technical skills, which might unveil new facets of the emergence and specification of patient responsibilities. A potential sample selection bias might remain undetected.

Thus, the paper calls for complementary research activities building upon the proposed findings. First, the conduct of additional interviews engaging a wider, more heterogeneous population can deliver deeper insights on patients' attitudes and behaviors while illuminating sample characteristics and differences. Second, subsequent studies should promote further development and extension of propositions that are suitable to be transferred into testable hypotheses, which then again represent the foundation for quantitative studies, e.g., in the form of online surveys. In doing so, generalizable insights can be achieved and further integrated within telemedicine design and application processes.

### 18.6 References

Adams, R. J., Stocks, N. P., Wilson, D. H., Hill, C. L., Gravier, S., Kickbusch, L., & Beilby, J. J. (2009). Health literacy-a new concept for general practice? Australian Family Physician, 38(3), 144–147.

Ahmad, F., Hudak, P. L., Bercovitz, K., Hollenberg, E., & Levinson, W. (2006). Are Physicians Ready for Patients With Internet-Based Health Information? Journal of Medical Internet Research, 8(3), e22. https://doi.org/10.2196/jmir.8.3.e22

Ajzen, I., & Madden, T. J. (1986). Prediction of goal-directed behavior-attitudes, intentions, and perceived behavioral-control. Journal of Experimental Social Psychology, 22(5), 453–474. https://doi.org/10.1016/0022-1031(86)90045-4

Baxter, P., & Jack, S. (2008). Qualitative case study methodology: Study design and implementation for novice researchers. The Qualitative Report, 13(4), 544–559.

Castro, E. M., Van Regenmortel, T., Vanhaecht, K., Sermeus, W., & Van Hecke, A. (2016). Patient empowerment, patient participation and patient-centeredness in hospital care: A concept analysis based on a literature review. Patient Education and Counseling, 99(12), 1923–1939. https://doi.org/10.1016/j.pec.2016.07.026

Compeau, D. R., & Higgins, C. A. (1995). Computer Self-Efficacy: Development of a Measure and Initial Test. MIS Quarterly, 19(2), 189–211. https://doi.org/10.2307/249688

Demiris, G., & Hensel, B. K. (2008). Technologies for an aging society: A systematic review of “smart home” applications. Yearbook of Medical Informatics, 17(01), 33–40. https://doi.org/10.1055/s-0038-1638580

Hojat, M., Louis, D. Z., Maxwell, K., Markham, F., Wender, R., & Gonnella, J. S. (2010). Patient perceptions of physician empathy, satisfaction with physician, interpersonal trust, and compliance. International Journal of Medical Education, 1, 83–87. https://doi.org/10.5116/ijme.4d00.b701

Kayser, L., Kushniruk, A., Osborne, R. H., Norgaard, O., & Turner, P. (2015). Enhancing the Effectiveness of Consumer-Focused Health Information Technology Systems Through eHealth Literacy: A Framework for Understanding Users’ Needs. JMIR Human Factors, 2(1), e9. https://doi.org/10.2196/humanfactors.3696

Kreps, G. L. (2017). The relevance of health literacy to mHealth. Information Services & Use, 37(2), 123–130. https://doi.org/10.3233/ISU-170828

Kvedar, J., Coye, M. J., & Everett, W. (2014). Connected health: A review of technologies and strategies to improve patient care with telemedicine and telehealth. Health Affairs, 33(2), 194–199. https://doi.org/10.1377/hlthaff.2013.0992

Mäkinen, M. (2006). Digital Empowerment as a Process for Enhancing Citizens’ Participation. E-Learning and Digital Media, 3(3), 381–395. https://doi.org/10.2304/elea.2006.3.3.381

Mueller, M., & Heger, O. (2018). Health at Any Cost? Investigating Ethical Dimensions and Potential Conflicts of an Ambulatory Therapeutic Assistance System through Value

Sensitive Design. Proceedings of the 39th International Conference on Information Systems (ICIS).

Mueller, M., Heger, O., Kordyaka, B., & Niehaves, B. (2019). Investigating the Influence of Information Incongruity on Trust-Relations within Trilateral Healthcare Settings. Proceedings of the 14. Internationale Tagung Wirtschaftsinformatik (WI).

Mueller, M., Knop, M., Reßing, C., Freude, H., Oschinsky, F. M., Klein, H. C., & Niehaves, B. (2020). Constituting Factors of a Digitally Influenced Relationship between Patients and Primary Care Physicians in Rural Areas. Proceedings of the 53rd Hawaii International Conference on System Sciences.

Nutbeam, D. (2008). The evolving concept of health literacy. Social Science & Medicine, 67(12), 2072–2078. https://doi.org/10.1016/j.socscimed.2008.09.050

Or, C. K. L., & Karsh, B.-T. (2009). A Systematic Review of Patient Acceptance of Consumer Health Information Technology. Journal of the American Medical Informatics Association, 16(4), 550–560. https://doi.org/10.1197/jamia.M2888

Osei-Frimpong, K., Wilson, A., & Lemke, F. (2018). Patient co-creation activities in healthcare service delivery at the micro level: The influence of online access to healthcare information. Technological Forecasting and Social Change, 126, 14–27. https://doi.org/10.1016/j.techfore.2016.04.009

Pantelopoulos, A., & Bourbakis, N. G. (2010). A Survey on Wearable Sensor-Based Systems for Health Monitoring and Prognosis. IEEE Transactions on Systems, Man, and Cybernetics, 40(1), 1–12. https://doi.org/10.1109/TSMCC.2009.2032660

Strauss, A. L., & Corbin, J. M. (1998). Basics of qualitative research: Techniques and procedures for developing grounded theory (2nd ed). Sage Publications.

Van Woerkum, C. M. (2003). The Internet and primary care physicians: Coping with different expectations. The American Journal of Clinical Nutrition, 77(4), 1016–1018. https://doi.org/10.1093/ajcn/77.4.1016S

Wilson, N. W., Couper, I. D., De Vries, E., Reid, S., Fish, T., & Marais, B. J. (2009). Inequitable distribution of healthcare professionals to rural and remote areas. Rural Remote Health, 9(1060).

# 19 Acceptance of Video Consultation by Patients in Rural Primary Care

| | |
|---|---|
| Title | **Investigating the Acceptance of Video Consultation by Patients in Rural Primary Care: Empirical Comparison of Preusers and Actual Users** |
| Number | **P13** |
| Authors | Marius Müller[1]<br>Michael Knop[1]<br>Björn Niehaves[1]<br>Charles Christian Adarkwah[2]<br><br>[1]University of Siegen<br>Kohlbettstraße 15<br>57072 Siegen<br><br>[2]Philipps-University Marburg<br>Karl-von-Frisch-Straße 4<br>35032 Marburg |
| Publication Type | Journal Article |
| Publication Outlet | JMIR Medical Informatics |
| Status | published |
| Full Citation | Mueller, M., Knop, M., Niehaves, B., Adarkwah, C.C. (2020), “Investigating the Acceptance of Video Consultation by Patients in Rural Primary Care: Empirical Comparison of Preusers and Actual Users”, JMIR Medical Informatics, Vol. 8 No. 10, p. e20813. |

**Table 39: Publication Overview (P13)**

# Investigating the Acceptance of Video Consultation by Patients in Rural Primary Care: Empirical Comparison of Preusers and Actual Users

*Abstract*: **Background**: The ongoing digitalization in health care is enabling patients to receive treatment via telemedical technologies, such as video consultation (VC), which are increasingly being used by general practitioners. Rural areas in particular exhibit a rapidly aging population, with an increase in associated health issues, whereas the level of attraction for working in those regions is decreasing for young physicians. Integrating telemedical approaches in treating patients can help lessen the professional workload and counteract the trend toward the spatial undersupply in many countries. As a result, an increasing number of patients are being confronted with digital treatment and new forms of care delivery. These novel ways of care engender interactions with patients and their private lives in unprecedented ways, calling for studies that incorporate patient needs, expectations, and behavior into the design and application of telemedical technology within the field of primary care. **Objective**: This study aims to unveil and compare the acceptance-promoting factors of patients without (preusers) and with experiences (actual users) in using VC in a primary care setting and to provide implications for the design, theory, and use of VC. **Methods**: In total, 20 semistructured interviews were conducted with patients in 2 rural primary care practices to identify and analyze patient needs, perceptions, and experiences that facilitate the acceptance of VC technology and adoption behavior. Both preusers and actual users of VC were engaged, allowing for an empirical comparison. For data analysis, a procedure was followed based on open, axial, and selective coding. **Results**: The study delivers factors and respective subdimensions that foster the perceptions of patients toward VC in rural primary care. Factors cover attitudes and expectations toward the use of VC, the patient-physician relationship and its impact on technology assessment and use, patients' rights and obligations that emerge with the introduction of VC in primary care, and the influence of social norms on the use of VC and vice versa. With regard to these factors, the results indicate differences between preusers and actual users of VC, which imply ways of designing and implementing VC concerning the respective user group. Actual users attach higher importance to the perceived benefits of VC and their responsibility to use it appropriately, which might be rooted in the technological intervention they experienced. On the contrary, preusers valued the opinions and expectations of their peers. **Conclusions**: The way the limitations and potential of VC are perceived varies across patients. When practicing VC in primary care, different aspects should be considered when dealing with preusers, such as maintaining a physical interaction with the physician or incorporating social cues. Once the digital intervention takes place, patients tend to value benefits such as flexibility and effectiveness over potential concerns.

*Keywords*: Video Consultation; Technology Acceptance; Digital Health Care Technology; Primary Care; Rural Areas; Telemedicine; Behavioral Intention; eHealth; Teleconsultation; Electronic Consultation; General Practitioners

## 19.1 Introduction

### 19.1.1 Background

In many countries, health care systems are facing increasing challenges that are obliging care providers as well as consumers to adapt. In many rural regions, a shortage of physicians, especially general practitioners (GPs), is obvious and will dramatically increase in the near future [1-3]. A smaller number of GPs will have to take care of a larger number of patients because of demographic changes and an aging population, and catchment areas will increase [4]. Furthermore, GPs—especially in rural areas—have problems finding successors for their practices [5,6]. As a result, imbalances, disparities, and inequitable distributions of care occur, which threaten the comprehensive provision of care and the maintenance of population-wide health [7,8]. The short-term availability of care and medical expertise to which patients are accustomed is at risk. Accordingly, the patients' readiness to change the process of care delivery represents a major governmental as well as scientific issue.

The digitalization of health care processes and treatments over the last two decades represents a promising measure to counteract these issues. A large number of digital technologies have been applied within different medical domains to bridge the emergent gaps in patient treatment, ranging from preventive tools to rehabilitation support systems [9]. For instance, technological advancements in care occur in the form of digitalized patient-physician communication and consultation via web-based video consultation (VC) [10], which enables, for example, remote examinations [11,12], virtual visits at patients' homes [13], and the involvement of relatives and caregivers [14]. Further applications cover the remote collection of patient data through user input or body-worn sensors measuring vital parameters [15,16]; digital prescriptions [17] and web-based scheduling [18]; web-based provision of information on diseases, symptoms, and treatments [19]; and telemonitoring of patients [20].

Clearly, the beneficial implementation, evaluation, and continuous use of health care technologies are vital [21]. A crucial factor for this is the users' acceptance of the technology in play [22,23]. Accordingly, the investigation of factors determining the acceptance of telemedical technology by patients in rural areas represents a major scientific task. Technology acceptance by patients has been subject to several studies [24-26], using models such as the Technology Acceptance Model (TAM) [27,28], the Unified Theory of Acceptance and Use of Technology (UTAUT) [29], or models based on the Theory of Planned Behavior (TPB) [30,31]. However, in the case of telemedicine, these models deliver varying results [23,32], using a wide spectrum of variables without preselection [33,34]. Furthermore, the proposed models often neglect contextual factors and have a narrow view of complex phenomena [35]. Prior models might deliver results that have low explanatory power with regard to primary care settings. Consequently, this study takes an exploratory approach to shed further light on the acceptance of VC as a prominent representative of telemedicine in primary care.

### 19.1.2 Objectives

Previous studies have looked at telemedical support, for example, in the form of mobile apps, in the case of specialized care and for specific indications, such as palliative medicine [36] or stroke care [13,37]. When looking at primary care, VC represents a telemedical solution that has already been used widely by GPs and specialists to offer innovative ways of patient care and to cope with increasing challenges. A few studies have investigated how patients and medical professionals experience the use of VC systems in primary care [38-42]. Although these studies delivered first insights into the use and acceptance of VC by patients, the focus was predominantly on the convenience and benefits of VC [39,40], and an in-depth study seeking to unveil the social, personal, technical, environmental, and organizational factors affecting the use of VC in primary care remains to be done. In addition, the samples involved do not account for the vast majority of patients who have not yet encountered VC for treatment and are thus still in the process of forming behavioral intentions and attitudes toward VC in primary care.

Thus, the objectives of this study are (1) to empirically identify factors that drive patient evaluation, acceptance, and utilization of VC technologies, using research on patients with and without experience in using such a system within rural primary care; and (2) to contrast these 2 populations to expose the differences and commonalities that are potentially rooted in digital interventions. On the basis of these findings, implications can be drawn for design, application, and theory. This paper contributes to understanding what is important to patients in their roles as preusers as well as actual users of VC. The paper focuses on primary care setting because it affects a majority of citizens, from chronic patients who are obliged to interact frequently with their physicians to patients with nonsevere and acute diseases that render visits and consultations occasional. As the supply situation mentioned earlier reveals rural areas are threatened by a shortage of GPs, this study investigates patients and practices in a representative rural area in Germany.

## 19.2 Methods

### 19.2.1 Study Design

We conducted a qualitative study, as part of a regional project agenda, empirically investigating the digitization of primary care practices and health care processes in the German setting, focusing in particular on the specific conditions in rural areas. With regard to our study design, we seek to empirically explore and identify factors that shape patients’ perceptions, evaluations, adoption, and continuous use of VC in the primary care setting, focusing on the patient perspective. We conducted semistructured interviews with patients with and without experience in using VC, which allows for a comparison of these 2 patient cohorts and unveil differences and commonalities in what is important to the patients. We draw upon the notion of preusers, who are “[...] individuals and groups who do not have well-developed notions of how digital technologies fit into or affect their lives” [31]. As telemedical solutions such as VC are not widely used in health care [43,44], this user group represents a majority of patients. On the other hand, some primary care practices have already adopted VC systems for patient treatment. Accordingly, the population of patients who have actually encountered telemedicine is growing, forming a group of actual users who potentially pursue different norms, beliefs, and behaviors. Hence, we engage both preusers and actual users for 3 reasons. First, the intention to use a system is a major predictor of actual use [27] and is formed beforehand based on expectations and, in many cases, lack of actual experience. Therefore, it is useful to interrogate preusers to shed light on the emergence of behavioral intentions. Second, to establish fair and equitable access to care, it is important to include all patients who have already used or potentially will use VC for treatment. This includes patients with a lack of technical affinity or willingness to participate in VC; hence, they might remain preusers. It is important to determine what drives or hinders these patients from using VC. Finally, from a provider’s perspective, the economic success of implementing telemedicine seems important. Here, achieving a critical mass of users is crucial, calling for comprehensive technology acceptance to transform preusers into actual users.

### 19.2.2 Data Collection

All 158 GP practices in the region of Siegen-Wittgenstein, Germany, were contacted and asked for their experience with VCs. Of these practices, only 2 GPs stated that they had intensive experience with this method of treatment. These 2 GP practices included VCs in their regular office hours, that is, patients can opt for a VC or a face-to-face consultation (FTFC). For a VC, patients have to register and book an appointment through the website of the GP practice. Afterward, a link is sent to the patient via a text message and email, specifying the date and time of appointment. Finally, the patient needs to click on the link to enter the conference room. The GP immediately gets a notification when a patient is online and can start the VC. Patients were offered VC use instead of FTFC. All patients who registered for a VC were consecutively asked to participate in the study to have a representative sample of practice attendees. Owing to the COVID-19 pandemic, there was great interest in VCs among patients, and only one patient in each practice refused to take part. In rural GP practices in Germany, the number of patients registered is higher on average than in practices in urban regions. Furthermore, the proportion of older patients is somewhat greater. This is also the case for the practices participating in this study.

We conducted 20 semistructured interviews, drawing samples from these 2 primary care practices. Interviews were carried out in 2 phases. In phase 1, we conducted 10 interview sessions (sample A) at the first site with patients who did not have any experience with VCs. Thus, sample A represents the preuser group. In phase 2, we conducted 10 additional interviews with participants from the second practice (sample B) who had already used a VC system to consult their physician. As 4 of these interviews took place digitally because of the COVID-19 pandemic, interviewees were asked to evaluate their VC experience despite the acute circumstances (eg, restrictions on personal contact) if possible. In doing so, we aimed to collect coherent data. Sample B forms the actual user group. Both samples were recruited via 2 GP practices, as mentioned earlier, who reached out to suitable patients willing to participate in the project, thus allowing a convenient (sample A) and purposeful (sample B) sampling approach [45]. The sample yielded a total of 22 interviewees, 9 women and 13 men, with an average age of 51.2 years (SD 19.2). Interviews took 26 min on average and were conducted from August 2019 to April 2020. The comprehensive sample and interview process characteristics are illustrated in Multimedia Appendix 1. The samples thus consisted of patients with different education levels, age, gender, and health status. We tried to recruit samples that (1) adequately represent the common client base of rural primary care practices in the investigated region and (2), in the case of sample B, can be seen as recurrent users of telemedicine according to the physicians and self-disclosure.

The interview guideline covered 5 questions groups seeking to unveil different factors explaining the patients' attitudes toward VC and adjacent telemedical solutions. Questions covered patient, social, environmental, and organizational as well as technical and interaction factors, building upon the classification by Or and Karsh [33]. The guideline was adapted between the interview phases to reflect on the varying level of experience with VC between samples. However, we did not change the guideline in between interviews of the same sample, thus avoiding the possibility that the interviewees' statements could influence each other. In doing so, we aimed for unbiased data because the attitudes and perceptions under investigation are highly individual. Both interview guidelines are presented in Multimedia Appendix 2. In the case of sample A, a technical scenario was presented to the interviewees at the beginning of each interview to allow for a common understanding of telemedical treatments. The scenario involved 2 components: first, a live VC with the GP about distance, for example, from home;

and second, mobile sensory equipment that enables patients to measure and transfer vital parameters (eg, blood pressure) on their own. In the case of sample B, for the sake of comparability, the application of sensor equipment besides the experienced VC was introduced to the interviewees at the end of each interview session. Here, we additionally asked for the patients' perception of the usefulness and applicability of the sensory equipment in future treatments.

The interviews were conducted in German by 2 members of the research group, audio recorded, and transcribed nonverbatim, leaving out pauses and off-topic exchanges of words. Before each interview, the interviewees signed an informed consent, inter alia briefing them about voluntariness, the anonymization and partial publication of data, and their right to withdraw their study participation. For the sake of analysis, comparability with literature, and reporting, the transcripts were translated into English. The study was approved by the data protection commissioner of the University of Siegen.

### 19.2.3 Data Analysis

To reflect our data collection procedure, we followed a two-phased data analysis approach consisting of an inductive phase, analyzing data from sample A, and a subsequent deductive phase, analyzing data from sample B. Here, the results from phase 1 are used for analysis in phase 2. This procedure allows factors to persist, but also to change, complement, or substitute each other or be canceled out entirely. In this way, differences as well as commonalities between preusers and actual users become visible.

In the first phase, we analyzed the data gathered from sample A inductively to identify and comprehensibly define the first set of relevant factors associated with preusers. We followed a three-step approach [46]. First, 2 authors coded the interview data independently. The approach proposed by Strauss and Corbin [47], consisting of open and axial coding, was followed. Selective codes were formed by subsuming redundant and/or related codes into superordinate categories that represent factors with regard to the patients' attitudes toward and their acceptance of the technologies involved. Second, the 2 coding authors discussed their individual categorizations, merging codes with similar reasoning and formulation, and resolved disagreements. Consequently, some of the standalone codes were subsumed under others because they represented a particular facet of the resulting factor. This procedure led to a first categorization scheme consisting of 3 groups, which involve 7 subsumed factors, and 1 standalone group, which forms a factor by itself. Finally, based on the elaborate scheme, each involved researcher recoded the data, assigning the 8 factors to the interviewees' statements. After that, a final discussion on categories, their dimensions and facets, and factor-to-data assignments was carried out.

In the second phase, we analyzed the data collected from sample B in a deductive manner. Here, the final coding scheme from the first phase was applied as the initial template to code the remaining data. Again, the data were coded in 3 steps as in phase 1. First, the authors independently assigned identified codes to the data, allowing new codes to emerge and existing codes to be redefined. Statements that did not fit in the coding scheme were again coded following the inductive approach described earlier (open, axial, and selective coding). This led to a new factor dealing with patient responsibilities and obligations, which included novel insights with regard to the actual user group. Second, step 2 was carried out analogous to the first phase, leading to a new merged categorization that comprised the extended 4 factor groups, followed by, finally, a recoding of the data by both members of the research group. Before recoding, the raters agreed upon the data segments to which codes were assigned. To check for interrater reliability of the coding performed, we calculated Cohen kappa [48] after the final recoding of all the data was done (see step 3 during data analysis). The resulting value of 0.75 indicates a substantial agreement in coding and, thus, sufficient reliability [49].

Multimedia Appendix 3 shows the quantity of interview coding that relates to the factors after recoding of the data and the number of interviews that involve the respective factor. Both samples are presented individually and complemented by total numbers.

## 19.3 Results

### 19.3.1 Overview

In total, 4 different design and application relevant factor groups (attitudes and expectations, human interaction, rights and obligations, and social factors), each with their respective subdimensions, emerged from samples A and B. Although the context and connotations of specific factors varied between our 2 samples, we explored interesting commonalities and differences. The presented findings come from the experiences of patients with no experience in digital or video-based treatment (sample A) and those who have already experienced VCs with their GP (sample B). To preserve the anonymity of interviewees and to avoid the potential delineation of interviews (eg, by their order), we assigned a random number (from A1/B1 to A10/B10) to each interview [46].

### 19.3.2 Attitudes and Expectations toward Telemedicine

#### *Usefulness of VC*

In general, participants linked the use of VCs to perceived benefits. Although participants from sample A focused on 3 specific, positive aspects, participants from sample B mentioned several more factors they considered useful.

Of the 10 participants from sample A, 8 assumed that VC could be useful in saving their trip to the physician's practice, as did the majority of interviewees from sample B. Participants associated the travel-saving effect of VC use with further benefits, that is, saving time and not being exposed to potential sources of infection from other patients:

> *"Via Skype or the like, I would be able to talk to my doctor, tell him my problems. And if he could solve my problems right away, I wouldn't have to go to the practice. That would be something I appreciate."* [Interview A6]

Participants from sample B found further aspects of VC beneficial, including higher flexibility to integrate an appointment into their daily routine and the prompt setting of a virtual appointment as opposed to an office appointment. Participants from sample B especially emphasized its practicality with regard to their own professional or informal obligations:

> *"Well, concerning organization, it was quite easy, and of course quite practical, because I hadn't to leave work. I had my appointment at 10 am, I just went into another room, where I was undisturbed. That's just very comfortable."* [Interview B9]

Furthermore, half of all participants from sample B mentioned that a video appointment appeared to be more focused because of its transparent time limit. When using a web-based application form to receive an appointment for VC, participants were able to choose between different time slots, each comprising 10 min. Therefore, some interviewees argued that the scope of a specific appointment appeared to be clearer and more narrowed through digitization, as the timeframes of the appointments were displayed by the program they used to connect with their physician. In addition, they distinguished between appointments where their physical presence was necessary and those where their digital presence was sufficient. Overall, participants from sample B differentiated the usefulness of telemedicine systems to a higher degree and acknowledged more perceived benefits from digital appointments than did participants from sample A.

***Security Aspects***

Although interviewees were asked about the potential and actual disadvantages of VC, participants from both samples emphasized the need for data security. Participants were generally aware of the sensitivity of their medical data and expressed their concerns about the possibility of misuse. Foremost, interviewees described their personal medical data as vulnerable and transparent:

> *"I already said it, the past shows how little you can trust the whole thing. I am as transparent as [...] this window."* [Interview A7]

> *"[...] Technology certainly has, the definition of it certainly is to support humans and to be helpful, but every coin has got two sides, therefore every technology used by bad people holds the possibility to be misused."* [Interview B8]

Although the majority of interviewees from both samples A and B considered data security an important issue and a fundamental precondition for fully trusting a telemedicine system, participants from sample B put such statements into another perspective by stating that they risked the possibility of data insecurity to enjoy the benefits of VC:

> *"But I don't necessarily look at it that way, you might say, well data security, but I'm not attaching too much value on such things. See, we've so much data to disclose every day, you just have to be alert."* [Interview B4]

> *"Well, it's [digital appointment] working with video, internet, whatever. Who knows if it's been recorded or what. In the beginning, I thought that way, but in the end, it's nonsense. If it happens, it happens."* [Interview B8]

Accordingly, interviewees were aware of the importance of personal data in relation to the use of digital appointments. Participants who actually used VC compared the possibility of a breach of data with the normality of the potential misuse of data they could experience in comparable situations. In the end, the threat of data interception by third parties did not seem to outweigh the perceived advantages of digital appointments.

***Operability of VC***

As an antecedent to using digital technology, participants discussed the benefits of a preferably easy operation of a VC system. Although interviewees from sample A talked about prospective barriers they might have to face to use VC, participants from sample B emphasized the actual operability of the system they used for digital appointments:

> *"My wife, she had to work with computers. Nowadays, she's just like me, overstrained. Because she didn't use it anymore."* [Interview A8]

> *"Well, it was really easy. When you're booking an appointment online, you have to register. Afterwards you just choose a time slot and you get an e-mail with a PIN, and within the e-mail there's a link. And you even didn't need to enter the PIN."* [Interview B3]

In addition, participants from sample B discussed possible features for extending the operability or functionality of the system they had experienced, such as the simultaneous transfer of personal medical data they collected by themselves (eg, blood pressure or coagulation level), better feedback functions while waiting for the physician to join the digital appointment, and an app to use instead of a website.

### 19.3.3 Human Interaction and its Impact on the Use of VC

***Human Contact***

Participants emphasized their need for personal and direct interactions. Although participants from both samples mentioned their concerns about technological changes leading to the replacement of direct physical contact between them and their physician, only participants from sample A expressed their wish for personal assistance regarding the use of VC at home. Overall, interviewees from sample A used the uniqueness of direct, personal human interaction as an argument to reject VC, whereas interviewees from sample B described situations in which they considered adequate digital appointments.

Nonetheless, for participants from both samples, personal contact with their physician remained highly important. Participants from sample A insisted on office visits and tended to exclude the possibility of audiovisual treatment from their own scope of action. Of the 10 participants from sample A, 8 mentioned the importance of a personal relationship with their physician, even if that meant accepting specific disadvantages. Similarly, participants from sample B also emphasized their need for office appointments as well:

> *"Even if you have to wait a long time, the personal contact, you have to keep it upright."* [Interview A1]
>
> *"It [video consultation] won't work for every situation, logically. You need a personal talk. You need that."* [Interview B4]

Participants from sample A clearly distinguished between a physical meeting with their physician and contact mediated by VC. They seemed to assume that through personal contact, physicians are able to provide them with better care. VC was seen to restrict the senses of the physician and therefore limit the scope of examining a patient:

> *"I don't want that; I like to have personal contact. I think just from the way a patient behaves, as a doctor you're able to recognize certain things [...] that cannot be transmitted through video."* [Interview A5]

In contrast, participants from sample B often assessed the appropriateness of a digital appointment through their actual interaction with their physician. They clearly perceived the specific limitations of a digital appointment, for example, the inability of their physician to examine them physically, to discuss severe diagnostic results, or deal appropriately in situations of high emotional stress:

> *"A digital appointment, it's limited by definition. You can't, like when you're actually in your physician's practice, get a sonography, for example."* [Interview B6]
>
> *"[...] when you get a bad diagnosis in a hospital and have to discuss it with your physician. When it's really serious, and you like to talk about it, I'd rather do it face to face."* [Interview B1]
>
> *"When I'm mentally unstable [...] when I face specific problems, I prefer to speak with someone in person. It's maybe, I don't know, it's a matter of trust [...]."* [Interview B4]

Overall, participants from sample B differentiated the occasions for the use of telemedicine, whereas participants from sample A expressed their concern regarding a potential lack of physical and personal contact with their physician. Therefore, participants from sample B were able to provide specific situations that they preferred not to be digitally mediated.

### *Trust in Physician*

Regarding the acceptance of digital appointments, participants from both samples discussed the relationship between them and their physician as a determining factor. Although even skeptical participants from sample A agreed to use VC when they were told to do so by their physician, interviewees from sample B emphasized the importance of trusting their physician to find the best medical solution for their problem, even without being physically present:

> *"If my doctor says "Hey look, I've got a cool thing here, we're able to communicate regularly. I am always there for you. If anything happens, you come to my practice, otherwise let's try it that way," I think if he says it that way, if the doctor I trust means it, it's more likely I'll do it."* [Interview A3]

> *"And I think there has to be a trusting relationship to your doctor. To really want to test it [video appointment], to try something new, and to have trust in your physician, that everything will be ok, when you're treated via video talk."* [Interview B3]

Although the role of the physician as a mediator between technology and the patient seemed to be essential to all participants, most interviewees from sample B indicated that nonetheless, some medical indications might justify digital treatment from an unfamiliar physician. Without being explicitly asked about it, some participants came up with the idea of being treated by unknown physicians for minor physical complaints (eg, a cold), a discussion of objective medical data (eg, test results), or highly urgent and acute symptoms (eg, an emergency):

> *"When it's just about a cold, or a cough, or whatever, it doesn't really matter who's treating me. As long as I've got the feeling of being taken seriously to some degree."* [Interview B5]

In summary, a trusting relationship between participants and physicians fostered a positive attitude toward the use of VC and might be considered an important condition for effective digital treatment. Furthermore, interviewees from sample B appeared to be partially willing to receive care from unfamiliar professionals to receive the perceived benefits from digital appointments.

### 19.3.4 Rights and Obligations

#### *Voluntariness of Use*

Participants from both samples liked the idea of video appointments being an optional extension of the already existing primary care services and emphasized that using it needed to be a voluntary choice. Participants from sample B in particular recognized that choosing between a digital or an office treatment involved a bilateral process of negotiation between them and their physician:

> *"It would be nice if my doctor doesn't tell me to use it, but if he makes me an offer with specific advantages."* [Interview A2]
>
> *"I think, I would appreciate having a voice. It's one thing to say, well, when my doctor asks me "could we talk about it digitally?" [...] But you have to have a choice to say "no, I'd like to speak to you in person.""* [Interview B5]

Although participants would clearly like to choose a specific type of medical service voluntarily, interviewees also realized that their health status sometimes indicated a specific kind of medical service (digital or office) and agreed to follow the advice of their physician:

> *"If you've got minor questions, concerning your medication or high blood pressure or anything else. Then you don't have to come here, just get such a long distance consultation."* [Interview A4]
>
> *"[...] and some appointments can be digitalized, you might ask your patient, what can be done digitally and when do you need an actual [office] appointment."* [Interview B4]

In general, participants from both samples seemed to express their wish to participate in the decision-making process regarding whether a digital appointment appeared to be adequate in a specific situation. Acknowledging the primary care physician's professional assessment of their health status and indication for a specific service (digital or office treatment), participants emphasized the importance of the voluntary use of VC.

#### *Availability of Care and VC*

Participants from both samples were concerned about a present or future shortcoming of medical service in general because of a lack of professionals. Interviewees gave examples of long waiting times to get office appointments and severe problems in reaching their physician's medical assistants via telephone:

> *“Nobody answers the phone, when you’ve got something important to tell. Nobody’s answering it.”* [Interview A1]

> *“When I look at it, well, members of my own family were diagnosed with cancer tentatively, they needed an MRI really quick. They had to wait six months, every day they died of worry.”* [Interview B8]

Broaching the issue of VC, participants from both samples generally described digital appointments as an opportunity to increase reachability and shorten waiting time:

> *“In the morning I asked myself if I should go to the [physician’s] practice. Then I remembered he’s offering that service [digital appointment]. I logged in and had a look at it. When I had a closer look, I realized there was a slot vacant at 11 am. Wouldn’t have got a real [office] appointment that quick.”* [Interview B4]

Although participants from sample B emphasized the benefit of digital appointments in increasing the availability of medical services and as an opportunity for primary care physicians to increase the number of patients they are able to care for, participants discussed potential disadvantages from their physician’s perspective, for example, an increased workload and unnecessary appointments because of the simplicity and availability of digital appointments. However, overall, participants from sample B suggested that VC might be able to counter the present challenges regarding the provision of care, which were mentioned by nearly all participants from both samples.

### *Patient Responsibilities*

Only participants from sample B discussed the matter of self-responsibility regarding digital appointments. They mentioned that their own technological competence fostered the smooth processing of a digital appointment and that their own preparations were necessary beforehand:

> *“Someday you’ll use it [video consultation] the first time and then you may realize that the camera won’t work or something. Surely, patients have to prepare. I’ve got the feeling, such an [digital] appointment, I have to write it in my calendar, it’s easy to forget, rather than actually going to the practice.”* [Interview B10]

Necessary preparations were not reduced to technological issues. Participants mentioned that they had to focus on a specific issue rather than portray their pathogenetic history extensively. Furthermore, participants from sample B emphasized the importance of the competence to interpret one’s own symptoms and decide on an office or digital appointment:

> *“Well, you’ve got a certain period of time, and when I’ve got my appointment, I know I can’t tell the whole story around it, for a quarter of an hour, but there are specific things [...]”* [Interview B9]
>
> *“But I think everyone’s able to judge, depending on your symptoms or pre-existing conditions, whether or not you have to go to the physician’s practice or if it’s suitable to use digital appointments.”* [Interview B3]

In this regard, participants suggested that patients should carefully assess their health status, potential issues, and appropriate ways of dealing with them. Overall, interviewees from sample B reflected on the conditions for a satisfactory use of VC regarding their own possibilities of shaping an interaction between themselves and their physician.

### 19.3.5 Social Factors

In general, several social factors influencing the use of technology can be found in our data. Unconsidered habitual attitudes toward digital technologies were often expressed in nonspecific, generic terms. Responses from both samples can be divided into statements concerning the social expectations of technology use in general and individual, private social interaction related to one’s own experiences with VC.

Interestingly, the majority of interviewees from sample A tended to express their readiness in a more passive way, assuring that they would not stand in the way of technological innovation, whereas participants from sample B stated their willingness to actively promote VC as an innovative technology. To explain user-specific readiness to use, participants from both samples often draw on stereotypes related to age:

> *“So, I believe the willingness of older people to learn something new isn’t there. If I want to deal with it [new technologies], I have to be competent. Otherwise, when a problem occurs, something won’t work, and when the problem occurs a second time, they just throw it away. That’s how I see it.”* [Interview A6]
>
> *“Well, my mother, she was born in 1943, she’ll have trouble using it [video consultation], because she doesn’t know how to handle a pc, how to use a video chat function.”* [Interview B8]

Participants from both samples reported the importance of talking to family members, friends, and colleagues about VC. Participants from sample A related their statements to relatively close family members and described their behavior as reactive, whereas interviewees from sample B considered themselves as being one of the first among their peers to use such innovative technology:

> *"They always try to motivate us. "Daddy do this, do that," they know I always decline, but their father complies with it."* [Interview A4]
>
> *"Well, when I talk about it [use of video consultation] with my former wife, I have to add, we've got a good connection [...] she said, she'll give it a try, because you're just more flexible when you're an employed person."* [Interview B9]

Overall, participants from sample B appeared to see themselves as pioneers when using VC. They actively discussed their experiences of digital appointments with peers and seemed to influence others rather than be influenced. Nonetheless, social interaction and the impact of social expectations and norms, including stereotypes, remain an essential factor in the use of technology.

### 19.4 Discussion

The results shed light on factors that influence the attitudes, acceptance, and behavior of patients regarding the application of VCs as a representative of telemedicine in rural primary care. Studying preusers and actual users of telemedical solutions enables the empirical comparison of these 2 populations. The main findings are discussed against the background of technology design, application, and theory, thus delivering implications for practitioners, developers, and researchers.

#### 19.4.1 Differences in the Perception of Benefits and Security Issues

With regard to the participants' expectations and perceptions toward the application of telemedicine in primary care, they showed high levels of perceived usefulness and beneficial effects of the technology. The literature on technology acceptance and adoption behavior has a vast corpus of studies that incorporate the perceived usefulness (TAM) and expected performance (UTAUT) of a technology as an antecedent to its use, together with associated intentions and attitudes [29]. A recent meta-analysis of research on the acceptance of consumer health technologies has shown that perceived usefulness can explain use behavior on a significant level [32]. Our study delivers further insights by considering both preusers and actual users of VC. As our findings indicate, preusers seem to attach less importance to the potential benefits of VC while focusing on other considerations for and against VC. Therefore, the inclusion of the patient's role (preuser vs actual user) as a factor within research models on the acceptance of VC in primary care appears promising.

The preuser group mentioned only a few benefits they could think of, such as avoiding long and repeated travel to the practice. In contrast, the actual user group cited more examples of profitable outcomes. They experienced VCs to be more focused, efficient, and flexible. Literature has shown that there is no significant difference between text-based, information technology–mediated consultations and FTFC with regard to effectiveness as perceived by patients [50]. Our findings complement prior research on the use of VC in primary care, which deemed VC as a more thorough and convenient treatment method compared with FTFC [40,41,51] and telephone consultations [39], and indicate that video-based consultations are perceived as more effective and targeted than FTFC. Interestingly, while perceiving VC as a thorough approach [41,52], patients comply with the time limits of concise video meetings. Despite the limited time given, patients are satisfied with the experienced VC. From a practical standpoint, this makes it easier for GPs to schedule and adhere to appointments. On the contrary, preusers lack the experience of VC being a sufficient and satisfactory way of treatment. Here, the temporal limitation of virtual sessions can hinder patients from opting for VC. As research shows, patients are oftentimes skeptical about their health issues being addressed via VC depending on their condition, which renders VC inapplicable in certain situations [39,40,51].

Accordingly, from a practical standpoint, to increase the acceptance and use intentions of preusers, telemedical solutions such as VC systems should be promoted in more detail, clarifying what a VC can and cannot accomplish. It can be assumed that a higher awareness of benefits can lead to increased intentional and proactive use. In this regard, the benefits of VC have become apparent during the ongoing COVID-19 pandemic, which has put restrictions on the physical contact between GPs and their patients [53]. In times where access to care is limited, the potential of VC to bridge spatial gaps between GPs and patients has led to an uptake in VC implementation and use [54]. This is particularly true in rural areas that often lack comprehensive access to care [7]. Telemedicine, and VC in particular, enables GPs and clinicians to cope with given restrictions, maintain care of infected patients as well as those not related to COVID-19, and decrease infection rates [54].

As research shows [39], although the operability, usability, and ease of use of VC as well as the process of familiarizing oneself with the system are important to both user groups, the prevalence of security concerns and associated behavior varies. Although research on VC in primary care has focused primarily on the patient's security in the sense of reducing physical harm and achieving health progress, our findings represent a novel aspect that contrasts preusers and actual users of VC. The preuser group indicates great concerns regarding the security of telemedicine and the potential of data misuse and leakage. In addition, preusers tend to affiliate these concerns with the intention of not using telemedicine. Actual users, while still aware of security issues, seem to be more willing to take risks in light of experienced benefits and convenience. The actual use of and exposure to telemedicine seems to alleviate patients' concerns regarding technology-associated security. Literature has shown that the perceived benefits of technology use can outweigh perceived risks [55]. Accordingly, technology design should focus on alleviating the risks and threats perceived by preusers. From a design standpoint, to increase patients' trust in telemedicine, technologies should present their privacy policies in an accessible and understandable way [56]. It appears to be important to incorporate ways of displaying technical security measures to the patient while not requiring high levels of technical skills, for instance, in the form of protection-ensuring labels [57] or a lucid and manageable list of people and institutions having access to the data [58]. This information can also be delivered to preuser patients by GPs to alleviate potential concerns that might not be perpetuated once the VC is experienced.

### 19.4.2 Impacts of VC on the Patient-Physician Relationship

In the context of human interaction and its impact on the use of VC, the results indicate the importance of maintaining physical contact with the physician. The preuser group in our study expects fewer positive outcomes for virtual treatments and tends to reject the technology because in-office treatment by the physician is perceived to be superior. This finding is in line with prior studies on VC primary care, which indicate that the lack of physical contact potentially impedes adequate examination and proper treatment [59,60]. VC was deemed useful in nonurgent or routine situations [51]. In addition to this occasion-based opting for VC or FTFC, as our findings show, several patients requested aid by a competent person (eg, medical staff or peers) in case they had to use VC. This finding closely relates to the facilitating conditions that form an antecedent of the intention to use as well as the actual use of a technology in the UTAUT model. In particular, the model states that the degree of guidance and support experienced by the user when opting for a technology has an effect on their willingness to (continuously) use it [24,29]. Concerning our findings, this relation seems to be particularly relevant when dealing with preusers of VC in primary care. In the meantime, actual users seem to be able to fathom the feasibility and applicability of VC, enabling them to identify occasions and health issues that a digital treatment can address while placing less importance on guidance or external support. Apparently, patients are more able to differentiate occasions for office or digital treatments once they have conducted a VC with the physician. This finding concurs with studies that have shown that patients gain deeper knowledge about the occasions that are suitable for VC in comparison with FTFC when actively using the system [51].

Closely related to the relationship between patients and physicians, participants from both samples indicated that trust in the respective physician and an existing relationship are major drivers of technology acceptance and willingness to use it. Looking at investigations on technology acceptance and adoption behavior, trust in the opposite party (here, GPs offering VC) and their actions represents an important factor in the users' technology assessment [32]. The findings indicate that a trusting patient-physician relationship increases the belief in an effective, beneficial, and safe treatment via VC, which is in line with prior studies on VC in primary care [39]. In the case of preusers, the data suggest that even obligatory technology use becomes more acceptable once interpersonal trust is achieved. Although actual users of VC have concrete experiences and specific benefits at their disposal, preusers tend to use trust as a heuristic input to decision making, making it easier for them to form an attitude [61]. Accordingly, the physician's proactive invitation to arrange a digital appointment can potentially achieve higher use intentions once the relationship is considered trustworthy. By offering VC to the patient as an alternative to FTFC, the GP conveys that the virtual treatment is deemed suitable and beneficial, which could mitigate a patient's potential concerns.

Revealing another interesting finding that complements the literature on VC in primary care, our study suggests that patients are partially willing to be treated via VC by a physician who is not their regular GP. Apparently, there are health-related occasions that go beyond the choice between VC and FTFC, which has been subject to prior studies [40,62-64] and further subdivide the feasibility of VC based on the need for trust. Both our findings and the literature show that there are suitable issues that can be addressed via VC but that call for different degrees of trust in the treating physician, such as receiving a severe diagnosis. There is still ambiguity on whether patients prefer a comforting environment (eg, at home) or an FTFC when talking about issues that are perceived to be sensitive or serious [60]. However, our findings reveal that there are health issues (such as a cold) that do not call for an already existing relationship with the physician. Accordingly, bringing together such patients with GPs who offer VC and are available for consultation represents a promising treatment model that further alleviates disparities in access to care. This concept can increase the number of patients who are suitable for treatment via VC while reducing the workload for the GPs responsible. This is particularly relevant in today's health care because patients who can be treated virtually represent only a fraction of the clinical workload [63]. Therefore, based on the patient's indication, perceived severity, and need for a trustworthy relationship, connecting patients with available physicians other than their own GP via VC promises a flexible and cost-effective way of delivering treatment [65].

### 19.4.3 Emerging Tasks and Freedoms for Patients in a Virtual Setting

Looking at the patients' rights and obligations that come along with the introduction of VC in primary care, the results show emerging freedoms, tasks, and behavioral patterns that patients should be aware of. Both samples wished for a voluntary and autonomous use of VC that enables them to adopt or reject the technology without disadvantages. The literature on technology acceptance has already identified the degree of voluntariness when choosing a technology as an important factor that influences users in their decision making [28,29]. Further research in the domain of health care technologies identified the patients' freedom and preferences when choosing between VC and FTFC as an important factor that fosters their adoption or rejection of VC [40,51,59,60]. Our findings complement these studies by shedding light on the scenario in which using VC in primary care becomes obligatory and free of alternatives, for instance, in remote areas with detrimental access to care or in times of viral outbreaks such as the COVID-19 pandemic. Although the preuser group mentioned that they were willing to use an obligatory VC system if their physician suggested it, the actual user group indicated that they would obey telemedical obligations if they deemed the treatment occasion appropriate. That is, once a patient experiences VC and is able to fathom its applicability, the need for freedom of choice seems to decrease. Instead, actual users of VC tend to agree with obligatory digital appointments because they have gained the know-how regarding the way VC is applied in primary care. Theoretically speaking, they might have achieved higher levels of health literacy, which enables them to assess and understand health issues and necessary treatments [66] and computer self-efficacy, making them more competent in adequately choosing and using VC [67]. This is in line with previous research indicating that illiteracy with regard to proper technology use is a barrier to opting for VC instead of FTFC [68].

In addition to the degree of voluntariness in the use of VC, digital primary care also comes with obligations for the patient. Looking at prior research on the use of VC in primary care, our findings complement the first insights on the patient's role in achieving an effective and satisfactory experience and use of technology. One of the first studies on VC in primary care indicated that patients perceive "[…] that they had responsibilities in ensuring the VC happened in an appropriate way, for example, conducting the VC in an appropriate setting […]" [39]. Further research raised the need for patients to prepare for a VC session, for example, by finding a private room and using headphones to secure privacy, as a novel consideration that is unique to telehealth [60]. Our data complement these findings and suggest that patients become aware of their roles and responsibilities through the actual use of the technology. Although the first sample did not mention this issue, the actual user group described the need to assess the feasibility of digital treatment as opposed to a physical visit. The participants stressed that prevalent health issues and potential treatments should be considered before making an appointment. When the participants considered a treatment via VC inappropriate for solving the health issues, they emphasized that a patient should be able to reject a digital appointment. Again, this requires patients to achieve higher levels of health literacy, so they are able to understand their condition, possible treatments, and the potential of telemedicine. Physicians might actually need to increase the effort of patient empowerment to ensure a degree of health literacy, which enables patients to decide what kind of treatment is appropriate in a specific situation [69,70]. With regard to technology design, the VC system can provide information about potentially prevalent diseases, feasible treatments, and contacts to specialized care to increase the patients' health literacy and degree of empowerment. This information and potentially resulting measures by the patient can also be used to inform upcoming VCs, enriching patient-physician communication and mutual understanding.

### 19.4.4 Social Impacts on the Use and Design of VC

The data show different views on social factors in using VC. Apparently, the preuser group incorporated social cues and external norms into their attitude toward VC. The data suggest a subconscious trend toward social conformity when talking about technology in primary care. Interestingly, both groups gave credence to social stereotypes, claiming telemedicine to be more appropriate for younger generations. Preusers therefore seem to act according to what they think is the social norm, as suggested by prior studies on technology acceptance behavior [29,71,72]. In contrast, actual users talk about their influence on their peers. They appear (to themselves) to be innovative pioneers and inform their social cues about their mostly positive experiences. This is closely related to the image of the user (which the UTAUT model incorporates) coined as "[…] the degree to which use of an innovation is perceived to enhance one's image or status in one's social system" [29]. Although our findings show no support for actual users intentionally seeking to improve their image, their positive influence on their peers' assessment of VC for treatment can still be identified. Thus, the patients' self-perception as the first adopter of VC within their social system holds the potential to further explain why patients opt for VC in primary care and stick with it.

In addition, prior research on the use of VC in primary care has already shown that specific patient groups, such as older adults and the housebound, are perceived by GPs as not having the degree of technical skill to use VC effectively, although they would benefit from it the most [38]. Interestingly, the demographics of patients who opt for VC and those who do not differ significantly [68], indicating a social bias in the form of stereotyping [73]. Our study enhances these findings by indicating that lack of skill is also perceived among patients. As a result, to profit from the social dissemination of VC and its benefits, the resolution of these perceived gaps between patient groups by practitioners and policy makers seems necessary. GPs, for instance, are potentially able to achieve mutual understanding between patients and thus increase the intention to use VC by being transparent about the actual use of VC by different populations, including older adults. Furthermore, identified pioneers of VC can serve the GP as gatekeepers who influence their peers in a positive way.

At the design level, incorporating social cues and the adoption behavior of peers into telemedicine, and VC in particular, can potentially increase a patient's willingness to (continuously) use it. Preusers, in particular, seem to highly value opinions and assessments by their peers. With regard to actual users, research shows that experienced users of virtual consultation increasingly form negative attitudes toward the use of the system [51]. From a theoretical standpoint, establishing and maintaining the use of VC can be achieved by finding ways to present behaviors of others to the patient, following the concept of nudging [74]. The idea of nudging is to gently encourage people to behave in a certain way at a subconscious level [75]. Nudges in the form of messages presented to the patient (eg, "Most of your friends have used VC before to contact their physician.") can potentially lead to higher use intentions. Our findings expand prior research that shows that digital nudges can positively influence the willingness to use novel technologies in hospitals [76]. In turn, our findings contribute to the theoretical concept of nudging by indicating that the use of social norms as a nudging option [74] holds the potential to increase the acceptance rate of VC in primary care.

### 19.4.5 Limitations

This study has some limitations. First, the sampling procedure is prone to selection bias because we did not strictly regulate participant characteristics and demographics. Thus, the sample yields varying degrees of technical affinity and age, which could frame the results in a certain direction. People opting for telemedicine (representing sample B) might exhibit particular characteristics such as dispositional innovativeness that could partially explain patient perceptions and behavior. In addition, the interviews were partially conducted during the COVID-19 pandemic, which could have influenced the responses of the participants. As VC is the only way for many patients to consult their GP, at least during the acute times of the pandemic, interviewees might have formed stronger intentions and more positive reactions to the technology. Second, it is difficult to discuss identified factors in comparison with patients living in urban areas because the data are limited to the chosen context. The urban patients' experiences of VC and their intention to participate might differ with regard to the varying structural circumstances and quantity of practitioners. Third, participants were recruited in a limited region. Nevertheless, this area is representative of rural regions in Germany according to size and demographic characteristics. Further studies should be conducted to shed light on urban environments and enable rural-urban comparisons in a reliable and insightful way.

### 19.4.6 Conclusions and Outlook

This study investigates factors that constitute patients' attitudes, perceptions, and technology acceptance behavior regarding the use of VC in the rural primary care setting. To account for different levels of experience with technology use, this study involves the perspectives of preusers as well as actual users of VC. The empirical data enable the comparison of these 2 perspectives and the provision of implications for the design, application, and theory of VC. The study delivers an in-depth description and discussion of patients' experiences and attitudes that complement our understanding of the use of VC in primary care by involving both preusers and actual users of VC. The findings can be of interest to researchers, medical practitioners, and designers of VC and telemedicine solutions, further enabling them to increase the behavioral intentions of preusers, maintain continuous use of VC by already experienced patients, and achieve a critical mass of patients participating in digital treatments.

With regard to the patients' behavioral intentions toward and actual use of VC in primary care, that is, their technology acceptance behavior, this study unveils several links to established models and includes antecedents of health care technology acceptance. Interestingly, when looking at models that have been put up and tested by researchers to investigate patients' acceptance of consumer health technologies, none of these models (TAM, TPB, or UTAUT) combines the factors of perceived usefulness, trust in GP, social norms and image, degree of voluntariness and obligatory use, patient responsibility and involvement, and need for physical contact, which our findings suggest [32]. Hence, proposing and testing a theoretical model that integrates these antecedents represents a promising avenue for technology acceptance researchers when investigating the use and acceptance of VC in primary care. In addition, the comparison of user groups shows that the priorities, needs, expectations, and attitudes toward using VC in primary care vary between preusers and actual users. Therefore, the inclusion of both patient groups appears to be feasible when testing new theoretical models of technology acceptance by patients. The role of the patient (preuser vs actual user) thus holds potential explanatory power when looking at antecedents of core constructs such as intention to use VC.

This paper opens up many further research opportunities for future work as well as for preceding studies. First, research can be conducted to further investigate the gap between different generations regarding their perceptions and opinions on telemedicine. The findings suggest that stereotyping takes place across all ages, that is, the association of older adults with a lack of technical skills or the perceived social pressure coming from younger generations. Second, to overcome the monomethod approach, studies engaging wider and more heterogeneous populations can be conducted, for instance, in the form of surveys conducted on the web or on the GP's site. In doing this, researchers can gather data with higher external validity and achieve further insights into how to implement digital technologies within the primary care setting, based on quantitative measures. Here, interventional studies appear to be feasible to shed light on the behavioral and attitudinal changes triggered by the use of digital technology. Third, to generate feasible and beneficial designs for technology, the involvement of technology experts and developers, working together in focus groups and workshops, can yield concrete technical features and innovations that further improve the comprehensive provision of primary care in rural areas.

**Acknowledgements**

This research was supported by the DIPRA project funded by Sparkasse Siegen.

**Conflicts of Interest**

None declared.

**Abbreviations**

**FTFC**: face-to-face consultation
**GP**: general practitioner
**TAM**: Technology Acceptance Model
**TPB**: Theory of Planned Behavior
**UTAUT**: Unified Theory of Acceptance and Use of Technology
**VC**: video consultation

**Multimedia Appendix 1**

Sample and interview characteristics

**Multimedia Appendix 2**

Interview guidelines

**Multimedia Appendix 3**

Code quantities

## 19.5 References

1. Adarkwah CC, Schwaffertz A, Labenz J, Becker A, Hirsch O. Burnout and work satisfaction in general practitioners practicing in rural areas: results from the HaMEdSi study. Psychol Res Behav Manag 2018;11:483-494 [doi: 10.2147/PRBM.S179503] [Medline: 30425595]
2. Adarkwah CC, Schwaffertz A, Labenz J, Becker A, Hirsch O. GPs' motivation for teaching medical students in a rural area-development of the motivation for medical education questionnaire (MoME-Q). PeerJ 2019;7:e6235 [doi: 10.7717/peerj.6235] [Medline: 30697479]

3. Broermann M, Wunder A, Messemaker A, Schnoor H, Gerlach FM, Sennekamp M. [Structuring and supporting specialist training in general practice: evaluation of a Hesse-wide mentoring program for doctors]. Z Evid Fortbild Qual Gesundhwes2018 Nov;137-138:69-76. [doi: 10.1016/j.zefq.2018.08.001] [Medline: 30297261]

4. Demiris G, Hensel B. Technologies for an aging society: a systematic review of "smart home" applications. Yearb MedInform 2008:33-40. [Medline: 18660873]

5. Adarkwah CC, Schwaffertz A, Labenz J, Becker A, Hirsch O. [Assessment of the occupational perspectives of general practitioners in a rural area. Results from the study HaMedSi (Hausärzte [GPs] for Medical education in Siegen-Wittgenstein)].MMW Fortschr Med 2019 Oct;161(Suppl 6):9-14. [doi: 10.1007/s15006-019-0919-4] [Medline: 31587169]

6. Mueller M, Knop M, Reßing C, Freude H, Oschinsky FM, Klein HC, et al. Constituting Factors of a Digitally Influenced Relationship between Patients and Primary Care Physicians in Rural Areas. In: Proceedings of the 53rd Hawaii International Conference on System Sciences. 2020 Presented at: HICSS'20; January 7-10, 2020; Hawaii, USA. [doi:10.24251/hicss.2020.447]

7. Wilson NW, Couper ID, De Vries E, Reid S, Fish T, Marais BJ. A critical review of interventions to redress the inequitable distribution of healthcare professionals to rural and remote areas. Rural Remote Health 2009;9(2):1060 [Medline: 19530891]

8. Politzer R, Yoon J, Shi L, Hughes R, Regan J, Gaston M. Inequality in America: the contribution of health centers in reducing and eliminating disparities in access to care. Med Care Res Rev 2001 Jun;58(2):234-248. [doi:10.1177/107755870105800205] [Medline: 11398647]

9. Kvedar J, Coye MJ, Everett W. Connected health: a review of technologies and strategies to improve patient care with telemedicine and telehealth. Health Aff (Millwood) 2014 Feb;33(2):194-199. [doi: 10.1377/hlthaff.2013.0992] [Medline:24493760]

10. Almathami HK, Win KT, Vlahu-Gjorgievska E. Barriers and facilitators that influence telemedicine-based, real-time, online consultation at patients' homes: systematic literature review. J Med Internet Res 2020 Feb 20;22(2):e16407 [doi: 10.2196/16407] [Medline: 32130131]

11. Seuren LM, Wherton J, Greenhalgh T, Cameron D, A'Court C, Shaw SE. Physical examinations via video for patients with heart failure: qualitative study using conversation analysis. J Med Internet Res 2020 Feb 20;22(2):e16694 [doi: 10.2196/16694] [Medline: 32130133]

12. Host B, Turner A, Muir J. Real-time teleophthalmology video consultation: an analysis of patient satisfaction in rural Western Australia. Clin Exp Optom 2018 Jan;101(1):129-134 [doi: 10.1111/cxo.12535] [Medline:28436157]
13. Appireddy R, Khan S, Leaver C, Martin C, Jin A, Durafourt BA, et al. Home virtual visits for outpatient follow-up stroke care: cross-sectional study. J Med Internet Res 2019 Oct 7;21(10):e13734 [doi: 10.2196/13734] [Medline:31593536]
14. Funderskov K, Raunkiær M, Danbjørg DB, Zwisler A, Munk L, Jess M, et al. Experiences With Video Consultations in Specialized Palliative Home-Care: Qualitative Study of Patient and Relative Perspectives. J Med Internet Res 2019 Mar21;21(3):e10208 [doi: 10.2196/10208] [Medline: 30896436]
15. Pantelopoulos A, Bourbakis N. A survey on wearable sensor-based systems for health monitoring and prognosis. IEEE Trans Syst Man Cybern C 2010 Jan;40(1):1-12. [doi: 10.1109/tsmcc.2009.2032660]
16. Vesnic-Alujevic L, Breitegger M, Guimarães Pereira A. 'Do-it-yourself' healthcare? Quality of health and healthcare through wearable sensors. Sci Eng Ethics 2018 Jun;24(3):887-904. [doi: 10.1007/s11948-016-9771-4] [Medline: 27029478]
17. Mayakul T, Ayuthaya SD. A digital prescription refill system based on healthcare standard in Thailand. Int J Appl Biomed Eng 2018;11(1):28-35.
18. Nazia S, Ekta S. Online Appointment Scheduling System for Hospitals–An Analytical Study. Int J Innov Res Sci Eng Technol 2014;4(1):21-27.
19. Ahmad F, Hudak PL, Bercovitz K, Hollenberg E, Levinson W. Are physicians ready for patients with internet-based health information? J Med Internet Res 2006 Sep 29;8(3):e22 [doi: 10.2196/jmir.8.3.e22] [Medline: 17032638]
20. Aamodt I, Lycholip E, Celutkiene J, Strömberg A, Atar D, Falk R, et al. Health Care Professionals' Perceptions of Home Telemonitoring in Heart Failure Care: Cross-Sectional Survey. J Med Internet Res 2019 Feb 06;21(2):e10362 [doi: 10.2196/10362] [Medline: 30724744]
21. Currie M, Philip LJ, Roberts A. Attitudes towards the use and acceptance of eHealth technologies: a case study of older adults living with chronic pain and implications for rural healthcare. BMC Health Serv Res 2015 Apr 16;15(1):162 [doi: 10.1186/s12913-015-0825-0] [Medline: 25888988]
22. Chau PY, Hu PJ. Investigating healthcare professionals' decisions to accept telemedicine technology: an empirical test of competing theories. Inf Manag 2002 Jan;39(4):297-311. [doi: 10.1016/S0378-7206(01)00098-2]

23. Harst L, Lantzsch H, Scheibe M. Theories predicting end-user acceptance of telemedicine use: systematic review. J Med Internet Res 2019 May 21;21(5):e13117 [doi: 10.2196/13117] [Medline: 31115340]

24. Kohnke A, Cole ML, Bush R. Incorporating UTAUT predictors for understanding home care patients' and clinician's acceptance of healthcare telemedicine equipment. J Technol Manag Innov 2014 Jul;9(2):29-41. [doi:10.4067/S0718-27242014000200003]

25. Samhan B. Patients' Resistance Towards Health Information Technology a Perspective of the Dual Factor Model of IT Usage. In: Proceedings of the 50th Hawaii International Conference on System Sciences. 2017 Presented at: HICSS'17;January 4-7, 2017; Hawaii, USA. [doi: 10.24251/hicss.2017.412]

26. Rahman M. Does Personality Matter When We Are Sick? An Empirical Study of the Role of Personality Traits and Health Emotion in Healthcare Technology Adoption Decision. In: Proceedings of the 50th Hawaii International Conference on System Sciences. 2017 Presented at: HICSS'17; January 4-7, 2017; Hawaii, USA. [doi: 10.24251/hicss.2017.407]

27. Davis FD. Perceived usefulness, perceived ease of use, and user acceptance of information technology. MIS Quarterly 1989Sep;13(3):319-240. [doi: 10.2307/249008]

28. Venkatesh V, Davis FD. A theoretical extension of the technology acceptance model: four longitudinal field studies. Manag Sci 2000 Feb;46(2):186-204. [doi: 10.1287/mnsc.46.2.186.11926]

29. Venkatesh, Morris, Davis, Davis. User acceptance of information technology: toward a unified view. MIS Quarterly2003;27(3):425-278. [doi: 10.2307/30036540]

30. Yan M, Or C. A 12-week pilot study of acceptance of a computer-based chronic disease self-monitoring system among patients with type 2 diabetes mellitus and/or hypertension. Health Informatics J 2019 Sep;25(3):828-843. [doi:10.1177/1460458217724580] [Medline: 28820007]

31. Deng Z, Mo X, Liu S. Comparison of the middle-aged and older users' adoption of mobile health services in China. Int J Med Inform 2014 Mar;83(3):210-224. [doi: 10.1016/j.ijmedinf.2013.12.002] [Medline: 24388129]

32. Tao D, Wang T, Wang T, Zhang T, Zhang X, Qu X. A systematic review and meta-analysis of user acceptance of consumer-oriented health information technologies. Comput Hum Behav 2020 Mar;104:106147. [doi:10.1016/j.chb.2019.09.023]

33. Or CK, Karsh B. A systematic review of patient acceptance of consumer health information technology. J Am Med Inform Assoc 2009;16(4):550-560 [doi: 10.1197/jamia.M2888] [Medline: 19390112]
34. Bagozzi R. The legacy of the technology acceptance model and a proposal for a paradigm shift. J Assoc Inf Syst 2007Apr;8(4):244-254. [doi: 10.17705/1jais.00122]
35. Salovaara A, Tamminen S. Acceptance or appropriation? A design-oriented critique of technology acceptance models. In: Isomäki H, Saariluoma P, editors. Future Interaction Design II. London, UK: Springer; 2009:157-173.
36. Steindal SA, Nes AA, Godskesen TE, Dihle A, Lind S, Winger A, et al. Patients' experiences of telehealth in palliative home care: scoping review. J Med Internet Res 2020 May 5;22(5):e16218 [doi: 10.2196/16218] [Medline:32369037]
37. Kim DY, Kwon H, Nam K, Lee Y, Kwon H, Chung YS. Remote management of poststroke patients with a smartphone-based management system integrated in clinical care: prospective, nonrandomized, interventional study. J Med Internet Res 2020Feb 27;22(2):e15377 [doi: 10.2196/15377] [Medline: 32130140]
38. Randhawa RS, Chandan JS, Thomas T, Singh S. An exploration of the attitudes and views of general practitioners on the use of video consultations in a primary healthcare setting: a qualitative pilot study. Prim Health Care Res Dev 2019 Jan;20:e5 [doi: 10.1017/S1463423618000361] [Medline: 29909798]
39. Donaghy E, Atherton H, Hammersley V, McNeilly H, Bikker A, Robbins L, et al. Acceptability, benefits, and challenges of video consulting: a qualitative study in primary care. Br J Gen Pract 2019 Sep;69(686):e586-e594. [doi:10.3399/bjgp19X704141] [Medline: 31160368]
40. Hammersley V, Donaghy E, Parker R, McNeilly H, Atherton H, Bikker A, et al. Comparing the content and quality of video, telephone, and face-to-face consultations: a non-randomised, quasi-experimental, exploratory study in UK primary care. Br J Gen Pract 2019 Sep;69(686):e595-e604. [doi: 10.3399/bjgp19X704573] [Medline: 31262846]
41. Johansson AM, Lindberg I, Söderberg S. Patients' experiences with specialist care via video consultation in primary healthcare in rural areas. Int J Telemed Appl 2014;2014:143824 [doi: 10.1155/2014/143824] [Medline:25243009]
42. Johansson AM, Lindberg I, Söderberg S. Healthcare personnel's experiences using video consultation in primary healthcare in rural areas. Prim Health Care Res Dev 2017 Jan;18(1):73-83. [doi: 10.1017/S1463423616000347] [Medline: 27640522]

43. Karsh B, Weinger M, Abbott P, Wears R. Health information technology: fallacies and sober realities. J Am Med Inform Assoc 2010;17(6):617-623 [doi: 10.1136/jamia.2010.005637] [Medline: 20962121]

44. Ranganathan C, Balaji S. Key factors affecting the adoption of telemedicine by ambulatory clinics: insights from a statewide survey. Telemed J E Health 2020 Feb;26(2):218-225. [doi: 10.1089/tmj.2018.0114] [Medline: 30874484]

45. Marshall MN. Sampling for qualitative research. Fam Pract 1996 Dec;13(6):522-526. [doi: 10.1093/fampra/13.6.522][Medline: 9023528]

46. Mueller M, Heger O. Health at Any Cost? Investigating Ethical Dimensions and Potential Conflicts of an Ambulatory Therapeutic Assistance System through Value Sensitive Design. In: Proceedings of the 39th International Conference on Information Systems. 2018 Presented at: ICIS'18; September 16-18, 2018; San Francisco, CA, USA.

47. Strauss A, Corbin J. Basics of Qualitative Research. Thousand Oaks, CA: Sage Publications; 1998.

48. Brennan RL, Prediger DJ. Coefficient kappa: some uses, misuses, and alternatives. Educ Psychol Measure 2016 Jul2;41(3):687-699. [doi: 10.1177/001316448104100307]

49. Landis JR, Koch GG. The measurement of observer agreement for categorical data. Biometrics 1977 Mar;33(1):159-174.[Medline: 843571]

50. Mirzaei T, Kashian N. Revisiting Effective Communication Between Patients and Physicians: Cross-Sectional Questionnaire Study Comparing Text-Based Electronic Versus Face-to-Face Communication. J Med Internet Res 2020 May 13;22(5):e16965 [doi: 10.2196/16965] [Medline: 32401213]

51. Mold F, Hendy J, Lai Y, de Lusignan S. Electronic consultation in primary care between providers and patients: systematic review. JMIR Med Inform 2019 Dec 3;7(4):e13042 [doi: 10.2196/13042] [Medline: 31793888]

52. Mair F, Whitten P. Systematic review of studies of patient satisfaction with telemedicine. Br Med J 2000 Jun3;320(7248):1517-1520 [doi: 10.1136/bmj.320.7248.1517] [Medline: 10834899]

53. Ohannessian R, Duong TA, Odone A. Global telemedicine implementation and integration within health systems to fight the covid-19 pandemic: a call to action. JMIR Public Health Surveill 2020 Apr 2;6(2):e18810 [doi:10.2196/18810] [Medline: 32238336]

54. Jakhar D, Kaur I. Potential of chloroquine and hydroxychloroquine to treat COVID-19 causes fears of shortages among people with systemic lupus erythematosus. Nat Med 2020 May;26(5):632. [doi: 10.1038/s41591-020-0853-0] [Medline:32269358]

55. Kehr F, Kowatsch T, Wentzel D, Fleisch E. Blissfully ignorant: the effects of general privacy concerns, general institutional trust, and affect in the privacy calculus. Info Systems J 2015 Mar 18;25(6):607-635. [doi: 10.1111/isj.12062]

56. Tsai J, Egelman S, Cranor L, Acquisti A. The Effect of Online Privacy Information on Purchasing Behavior: An Experimental Study. Information Systems Research 2011 Jun;22(2):254-268. [doi: 10.1287/isre.1090.0260]

57. Kelley PG, Bresee J, Cranor LF, Reeder RW. A 'Nutrition Label' for Privacy. In: Proceedings of the 5th Symposium on Usable Privacy and Security. 2009 Presented at: SOUPS'09; July 15-17, 2009; Mountain View, California, USA p. 1-12.[doi: 10.1145/1572532.1572538]

58. Benaloh J, Chase M, Horvitz E, Lauter K. Patient Controlled Encryption: Ensuring Privacy of Electronic Medical Records. In: Proceedings of the 2009 ACM workshop on Cloud computing security. 2009 Presented at: CCSW'09; November 1-4,2009; Chicago, Illinois, USA p. 103-114. [doi: 10.1145/1655008.1655024]

59. Fatehi F, Martin-Khan M, Smith AC, Russell AW, Gray LC. Patient satisfaction with video teleconsultation in a virtual diabetes outreach clinic. Diabetes Technol Ther 2015 Jan;17(1):43-48. [doi: 10.1089/dia.2014.0159] [Medline: 25296189]

60. Powell RE, Henstenburg JM, Cooper G, Hollander JE, Rising KL. Patient perceptions of telehealth primary care video visits. Ann Fam Med 2017 May;15(3):225-229. [doi: 10.1370/afm.2095] [Medline: 28483887]

61. Lewicki RJ, Brinsfield C. Framing trust: trust as a heuristic. In: Donohue WA, Rogan RG, Kaufman S, editors. Framing Matters: Perspectives on Negotiation Research and Practice in Communication. New York, USA: Peter Lang Publishing;2011:110-135.

62. Tates K, Antheunis ML, Kanters S, Nieboer TE, Gerritse MB. The effect of screen-to-screen versus face-to-face consultation on doctor-patient communication: an experimental study with simulated patients. J Med Internet Res 2017 Dec 20;19(12):e421 [doi: 10.2196/jmir.8033] [Medline: 29263017]

63.Greenhalgh T, Shaw S, Wherton J, Vijayaraghavan S, Morris J, Bhattacharya S, et al. Real-world implementation of video outpatient consultations at macro, meso, and micro levels: mixed-method study. J Med Internet Res 2018 Apr 17;20(4):e150 [doi: 10.2196/jmir.9897] [Medline: 29625956]

64. Armfield NR, Bradford M, Bradford NK. The clinical use of Skype—for which patients, with which problems and in which settings? A snapshot review of the literature. Int J Med Inform 2015 Oct;84(10):737-742. [doi:10.1016/j.ijmedinf.2015.06.006] [Medline: 26183642]

65. Sterling R, LeRouge C. On-demand telemedicine as a disruptive health technology: qualitative study exploring emerging business models and strategies among early adopter organizations in the United States. J Med Internet Res 2019 Nov15;21(11):e14304 [doi: 10.2196/14304] [Medline: 31730038]

66. Nutbeam D. The evolving concept of health literacy. Soc Sci Med 2008 Dec;67(12):2072-2078. [doi:10.1016/j.socscimed.2008.09.050] [Medline: 18952344]

67. Compeau DR, Higgins CA. Computer self-efficacy: development of a measure and initial test. MIS Quarterly 1995Jun;19(2):189 [doi: 10.2307/249688]

68. Barsom EZ, Jansen M, Tanis PJ, van de Ven AW, Blussévan Oud-Alblas M, Buskens CJ, et al. Video consultation during follow up care: effect on quality of care and patient- and provider attitude in patients with colorectal cancer. Surg Endosc2020 Mar 20 epub ahead of print. [doi: 10.1007/s00464-020-07499-3] [Medline: 32198552]

69. Osei-Frimpong K, Wilson A, Lemke F. Patient co-creation activities in healthcare service delivery at the micro level: the influence of online access to healthcare information. Technol Forecast Soc Change 2018 Jan;126:14-27. [doi:10.1016/j.techfore.2016.04.009]

70. Castro EM, Van Regenmortel T, Vanhaecht K, Sermeus W, Van Hecke A. Patient empowerment, patient participation and patient-centeredness in hospital care: a concept analysis based on a literature review. Patient Educ Couns 2016Dec;99(12):1923-1939. [doi: 10.1016/j.pec.2016.07.026] [Medline: 27450481]

71. Ajzen I. The theory of planned behavior. Organ Behav Hum Decis Process 1991 Dec;50(2):179-211. [doi:10.1016/0749-5978(91)90020-T]

72. Taylor S, Todd PA. Understanding information technology usage: a test of competing models. Inf Syst Res 1995Jun;6(2):144-176. [doi: 10.1287/isre.6.2.144]

73. Oakes P, Haslam S, Turner J. Stereotyping and Social Reality. Malden, UK: Blackwell Publishing; 1994.

74. Sunstein C. Nudging: A Very Short Guide. J Consum Policy 2014 Oct 16;37(4):583-588. [doi: 10.1007/s10603-014-9273-1]

75. Voyer B. ‘Nudging’ behaviours in healthcare: Insights from behavioural economics. British Journal of Healthcare Management2015 Mar 02;21(3):130-135. [doi: 10.12968/bjhc.2015.21.3.130]

76. Meske C, Amojo I, Poncette A, Balzer F. The potential role of digital nudging in the digital transformation of the healthcare industry. In: Marcus A, Wang W, editors. Design, User Experience, and Usability. Application Domains. Cham, UK: Springer International Publishing; 2019:323-336.

### 19.6 Multimedia Appendix 1

The table below illustrates the sample and interview process characteristics. Note that two of the interviews in sample A each engaged a married couple, leading to a total of 10 interviews but 12 interviewees.

| | **Characteristic** | **Sample A (Pre-users)** | **Sample B (Actual users)** | **Total** |
|---|---|---|---|---|
| **Participants** | | | | |
| | N | 12 | 10 | 22 |
| | Age (range) | 30 - 81 years | 23 - 69 years | 23 - 81 years |
| | Age (mean) | 59 years | 41 years | 51 years |
| | Gender | 5 females, 7 males | 4 females, 6 males | 9 females, 13 males |
| | Patient type | 7 acute, 5 chronic | 4 acute, 6 chronic | 11 acute, 11 chronic |
| **Interviews** | | | | |
| | N | 10 | 10 | 20 |
| | Time | August 2019 | February to April 2020 | |
| | Duration (range) | 17 - 37 min. | 19 - 47 min. | 17 - 47 min. |
| | Duration (mean) | 22 min. | 30 min. | 26 min. |
| | Sampling method | Convenient | Purposeful | |

**Table 40: Sample and Interview Characteristics**

## 19.7 Multimedia Appendix 2

***Interview guideline used for interviewing sample A***

General: Information about the interviewee

- Age and gender
- Professional situation and education
- Family status

1. Patient factors
    - Do you see a doctor regularly or in a fixed cycle?
    - Do you think that you can assess your health status and perform any necessary measures by yourself?
    - Have you ever encountered digital technologies in a health context?
    - How do you assess your skills in dealing with digital technologies?
2. Social factors
    - What do family/friends think about novel digital technologies?
    - How do others' experiences and opinions influence your own view/behaviour?
    - Are you being guided by others when using digital technologies?
3. Environmental factors
    - How do you assess the availability of medical care services in your area?
    - How is your connection to your doctor's practice? (Travel, duration, waiting time)
    - Does this influence your evaluation of technologies being used in health care?
4. Organizational factors
    - How would you describe the relationship with your general practitioner? (Differentiation between personal and digital contact, satisfaction, influence on evaluation of technology)
5. Technical and interaction factors
    - How do you assess the usefulness of digital technologies in healthcare, in general and personally?
    - What advantages and disadvantages do you see in the application of technologies?
    - Would you like to decide for yourself if and which technologies to use? What if you are "forced" to use it?

Closing

- How do you envisage future medical care, in general and personally?

***Interview guideline used for interviewing sample B***

General: Information about the interviewee

- Age and gender
- Professional situation and education
- Family status

1. Patient factors
   - Do you visit your family doctor's practice regularly?
   - How would you rate your skills in dealing with digital technologies and the video consultation in particular?
   - Did you have any concerns or expectations before the first use?
   - Can you describe your experience when using it the first time?
   - What were the significant changes or innovations for you?
2. Social factors
   - What do your family/friends think about telemedicine such as the video consultation?
   - How do others' experiences and opinions influence your own view/behaviour?
   - Are you being guided by others when using digital technologies and the video consultation in particular?
3. Environmental factors
   - How do you assess the availability of medical care services in your area?
   - How do you describe the accessibility of your medical practice? (Travel, duration, waiting time)
   - What influence does the video consultation have on this in your perception?
4. Organizational factors
   - How would you describe the relationship with your general practitioner? (Differentiation between personal and digital contact, satisfaction, influence on evaluation of technology)
   - Would you say that the video consultation has influenced this relationship?
   - How do you evaluate the digital treatment? (quality of treatment and procedure)
   - Do you notice differences between in-office and digital treatment?
5. Technical and interaction factors
   - How do you assess the usefulness of the video consultation, in general and personally?
   - What advantages and disadvantages do you see in the use of telemedicine?
   - What is your motivation to use it? Are there barriers?
   - Would you like to decide for yourself if and when you use telemedicine?

- In which situations do you prefer in-office over digital treatment?
- In your opinion, what does the long-term establishment of telemedicine such as the video consultation depend on?

6. Adjacent telemedical scenario
    - Can you imagine that other digital components are used for diagnostics and treatment besides the experienced video consultation? (e.g., mobile sensors, which record data and send it to the doctor)
    - Do you think such components are useful? If yes, in which situations?

Closing

- How do you envisage future medical care, in general and personally?

### 19.8 Multimedia Appendix 3

The following table depicts the quantities of selective codes (i.e., factors) that have been assigned to the data during the re-coding step. In addition, it is shown in how many interviews the respective factor occurred. Since we want to compare pre- and actual users of video consultations, the statistical data for both samples and in total are presented. Sample A yielded 260 and sample B 353 codes, which leads to a total of 613 codes.

| **Factors** | **Sample** | **Codes** | **Interviews** |
|---|---|---|---|
| **Human Contact** | | | |
| | Sample A | 33 (12 %) | 9 (90 %) |
| | Sample B | 45 (12 %) | 10 (100 %) |
| | Total | 78 (12 %) | 19 (95 %) |
| **Social Factors** | | | |
| | Sample A | 39 (15 %) | 9 (90 %) |
| | Sample B | 34 (9 %) | 10 (100 %) |
| | Total | 73 (11 %) | 19 (95 %) |
| **Usefulness of Video Consult.** | | | |
| | Sample A | 40 (15 %) | 10 (100 %) |
| | Sample B | 69 (19 %) | 10 (100 %) |
| | Total | 109 (17 %) | 20 (100 %) |

|  |  |  |  |
|---|---|---|---|
| **Security Aspects** |  |  |  |
|  | Sample A | 17 (6 %) | 7 (70 %) |
|  | Sample B | 17 (4 %) | 7 (70 %) |
|  | Total | 34 (5 %) | 14 (70 %) |
| **Voluntariness of Use** |  |  |  |
|  | Sample A | 25 (9 %) | 8 (80 %) |
|  | Sample B | 17 (4 %) | 10 (100 %) |
|  | Total | 42 (6 %) | 18 (90 %) |
| **Availability** |  |  |  |
|  | Sample A | 54 (20 %) | 10 (100 %) |
|  | Sample B | 60 (16 %) | 10 (100 %) |
|  | Total | 114 (18 %) | 20 (100 %) |
| **Trust in Physician** |  |  |  |
|  | Sample A | 16 (6 %) | 7 (70 %) |
|  | Sample B | 42 (11 %) | 10 (100 %) |
|  | Total | 58 (9 %) | 17 (85 %) |
| **Operability of Video Consult.** |  |  |  |
|  | Sample A | 36 (13 %) | 10 (100 %) |
|  | Sample B | 48 (13 %) | 10 (100 %) |
|  | Total | 84 (13 %) | 20 (100 %) |
| **Patient Responsibilities** |  |  |  |
|  | Sample A | 0 (%) | 0 (0 %) |
|  | Sample B | 21 (5 %) | 10 (100 %) |
|  | Total | 21 (3 %) | 10 (50 %) |

**Table 41: Code Quantities**