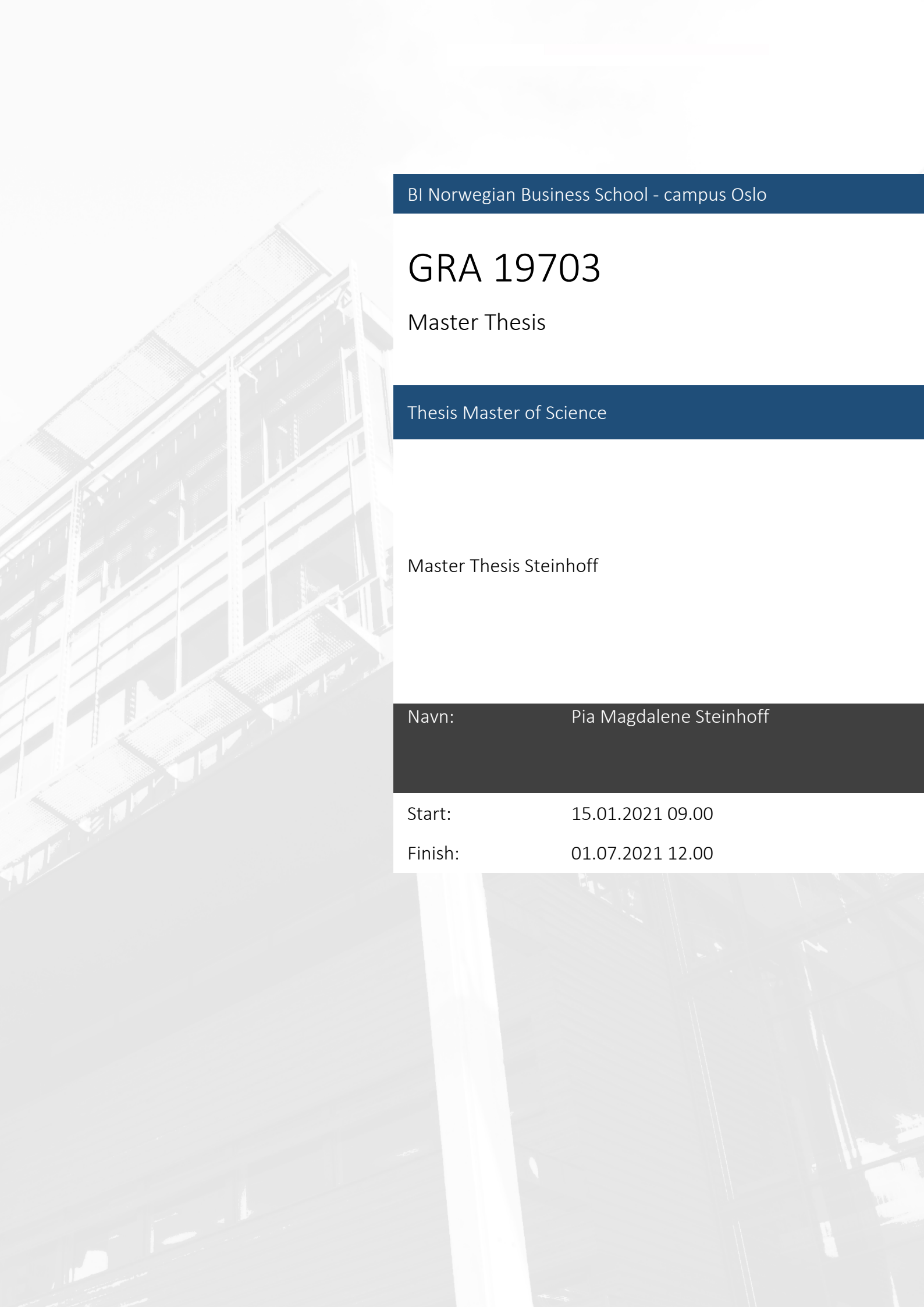

BI Norwegian Business School - campus Oslo

GRA 19703

Master Thesis

Thesis Master of Science

Master Thesis Steinhoff

Navn:	Pia Magdalene Steinhoff

Start:	15.01.2021 09.00
Finish:	01.07.2021 12.00

Master Thesis

- Investigation of the influencing factors of primary care physicians' intention to adopt new technologies for medical appointment management -

Hand-in date:
01.07.2021

Campus:
BI Oslo

Supervisor:
Hannah Snyder

Programme:
Master of Science in Business

ACKNOWLEDGEMENTS

Throughout the writing of this dissertation, I have received a great deal of support and assistance.

I would first like to thank my supervisor, Professor Hannah Snyder, whose expertise and guidance was invaluable to successfully complete this thesis. Thank you for your patient support, your flexibility and constructive criticism. It has truly been a pleasure.

Additionally, I would like to thank my friend Marte Solheim. You made me feel welcome and comfortable in a country where I knew nothing and no one, even more so in times of a global pandemic. Our friendship has kept me afloat and I am so grateful to have met you.

I would also like to thank my parents, who enabled me to get this excellent education and experience in the first place, for their wise counsel and sympathetic ear.

Finally, I could not have completed this dissertation without the support of my boyfriend, Bastian Bördner. You made it possible for me to stay sane and provided stimulating discussions as well as necessary and joyful distractions - no matter how long or short the distance was.

Thank you.

ABSTRACT

Background Long patient waiting times are a major concern within primary health care clinics, causing lower patient dissatisfaction and health care quality. Within several other industries, mobile queuing systems that use real-time order fulfilment are used to address similar issues. Due to the enormous potential user base that is associated with it, the primary health care sector represents a significant market opportunity, and the question arises as to what is necessary for such software systems to be adopted there as well. For this, the decision-making process of the practice managing physicians, as decision-makers, needs to be examined.

Objective The purpose of this study is to identify the influencing factors for primary care physicians' intention to use new appointment management systems that are based on real-time mobile queueing. Thereby, valuable insights for potential future development and promotion shall be derived.

Methods An adapted and extended version of the Unified Theory of Acceptance and Use of Technology (UTAUT) was developed as conceptual research model. A scenario-based survey experiment was chosen to answer the research hypotheses and questions.

Results The most important factor for the usage intention of physicians is Performance Expectancy. Furthermore, Options of Employees, Patients and Competitors were also found to have a significant influence on the usage intention of physicians. The paradox relationship between physician as decision-maker and patients as primary subject to potential advantage, was identified as most crucial aspect of adoption.

Keywords Patient waiting time, primary health care, mobile queueing, UTAUT, technology acceptance, diffusion of Innovation, real-time tracking

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1. Introduction

Medical consultations are indispensable in the life of every human being. This includes regularly required preventive care appointments, such as dental examinations, as well as spontaneously required consultations with e.g., a general practitioner for treatment of an acute infection. According to BARMER (2021), around 93 percent of the German population had contact with an outpatient physician in 2019, with an average of 10 annual visits per capita (OECD, 2020). A widely recognized and proven problem in this context is the increased occurrence of long patient waiting times despite scheduled appointments, i.e., the time a patient must wait from the scheduled time of his or her appointment until the actual examination. Since it is not possible to predict exactly when it will be their turn, a patient is usually obliged to stay within the practice premises until then, which is often perceived as ineffective and unpleasant by patients (Sherwin et al., 2013). Associated negative effects of patient waiting time have been demonstrated in several studies for many years. According to Camacho et al. (2006) and Probst et al. (1997), increased waits resulted in reduced patient satisfaction and decreased willingness to return (Xie & Or, 2017). It was also found to diminish the patients' perception of the physician's ability to perform health services reliably and accurately (Bleustein et al, 2014; De Man et al 2005 cited in Xie & Or, 2017). Finally, as it affects the timely, efficient, and patient-centered delivery of quality health care, patient satisfaction is often considered an effective indicator of physician and clinic success (Al-Harajin et al., 2019; Prakash, 2010). Commonly identified causes for long waiting time include inadequate staffing, limited resources, excess demand and primarily the unpredictable nature of health. Particularly the latter point has led to the general acceptance that prolonged waits are often inevitable and adequate solutions and innovations are still to be found (Xie & Or, 2017).

However, unavoidable queues do not only occur at medical practices, but in many other sectors as well. In order to counteract the associated negative effects of waiting times for customers, many industries are increasingly implementing mobile queueing, including retail, banking, telecommunications, gastronomy and others (Wavetec, n.d.). These systems are not primarily aimed at reducing waiting times, but much more at improving the circumstances of waiting for the customer. Here,

the consumer can join a virtual queue via phone or a similar device, optionally before arrival, and is thus free to move around while waiting. As soon as it is then their turn, a notification appears on the relevant device (Wavetec, n.d). To increase customer flexibility even further, areas such as transportation and delivery services, have complemented these systems by real-time order fulfillment tracking (myTrackee, (n.d.). Order fulfillment refers to the completion progress regarding the entire process from the inquiry of a specific service or product till the point of delivery (Burns, 2019). In this relation, real-time tracking involves an accurate temporal estimate about the remaining time till final delivery or completion of a specific process step at any moment in time (Cambridge Dictionary, n.d.a). Users receive an accurate wait forecast till the exact time of delivery and can therefore plan their time until the availability of service, even more flexible. The application of these systems has been proven to reduce waiting time, improve service quality, increase customer loyalty, enhance staff efficiency and further to reduce operational costs and increase revenue (Tšernov, K., n.d.a,b)

Considering the outlined situation within appointment management of outpatient practices, and the associated enormous potential user base, this sector represents a huge market opportunity for developers and distributors of respective systems. The question then arises as to what is necessary for such innovations to be adopted in the area of medical practices as well. As far as patients are concerned, it is not only their dissatisfaction with long waiting times that has been proven, but also their willingness to use appropriate mobile systems. For instance, in a study conducted in Germany by the Society for Social Research and Statistical Analysis, 73 percent of respondents stated that they would prefer an e-appointment scheduling service for their medical appointments (Forsa, 2017 cited in Abegg, 2020). The decisive factor is therefore on the side of the outpatient practice. They determine whether such a novel system is introduced or rejected. Correspondingly, it is necessary to analyze the decision-making process of the respective decision-maker and identify factors influencing their usage intention.

1.1. Research Objective and Contribution

Outpatient medical practices are usually physicians in private practice who are both owners and operators. Various studies exist that explore the adoption of new technologies by physicians (Dünnebeil et al., 2012; Gagnon et al., 2012; Hu et al., 1999; Ketikidis et al., 2012; Nguyen et al., 2020; Yarbrough & Smith, 2007). Research focusing on primary care physicians is however limited. Further, most studies are concerning the adoption of already implemented technologies such as Telemedicine (Hu et al., 1999), electronic health record (Gagnon et al., 2012; Beglaryan et al., 2017) or mHealth apps (Gagnon et al., 2016). The adoption of mobile queueing or queue management systems by physicians, however, has not been extensively explored.

This study aims to expand on previous research by providing a current and theoretically informed perspective on primary care physicians' acceptance of a new appointment management system that is based on real-time mobile queueing. Since this type of technology is not yet established in this sector, the focus lies on the decisive factors for the physician's intention to use, rather than the analysis of actual usage behavior. The purpose here is to identify facilitators and barriers to the adoption of these kind of systems in primary health care and derive valuable insights for potential future development and promotion.

Since the demand potential for this service innovation is based on a problem posed by patients, and they represent the other end of the two-way user relationship, it is crucial that the influence they exert on the physician is given special consideration in the process. The resulting research questions are as follows:

RQ1: What are determining factors that influence outpatient physicians' intentions to adapt a new technology for appointment management?

RQ2: How are the determining factors influencing outpatient physicians' intentions to adapt a new technology for appointment management?

RQ3: How is intention of outpatient physicians to adapt a new technology for appointment management affected by the opinion of their patients?

1.2. Structure and Course of study

Following the introductory description of the research problem and the objectives of this study, the rough process of appointment scheduling within outpatient practices will be explained at the end of this chapter to ensure a solid foundation of knowledge for the following work. Subsequently, the theoretical frame of reference for the study is established in Chapter 2. This involves the review of existing research and literature relevant to the context of this study, including the theory of diffusion of innovations, the characterization of health care as a service, and most importantly, the Unified Theory of Acceptance and Use of Technology (UTAUT) as the main theoretical concept used to develop the research framework of this thesis. Chapter 2 is thus intended to provide a theoretical foundation and facilitate a common understanding of the object of study. In Chapter 3, the conceptualization of the acceptance model for novel appointment management systems within medical practices is undertaken. To this end, relevant components are identified, assumed impact relationships are hypothesized, and an analysis model is developed. Following this, the research methodology for empirically testing the model is described in Chapter 4, including the process of data collection. In Chapter 5, the analysis of the data is conducted, and corresponding results are related to the developed research hypotheses. The findings are conclusively summarized and discussed in Chapter 6, along with recommendations for developers of similar service products, the limitations of the study and lastly recommendations for future research questions.

1.3. Medical appointment management and the issue of patient waiting time

When a person is in need of some sort of primary medical care, the sequence of various actions is set in motion (See **Figure 1**). From the initial inquiry up to the date of the appointment a constant dialogue is required between the personnel of the outpatient clinic responsible for the appointment scheduling and the prospective patient.

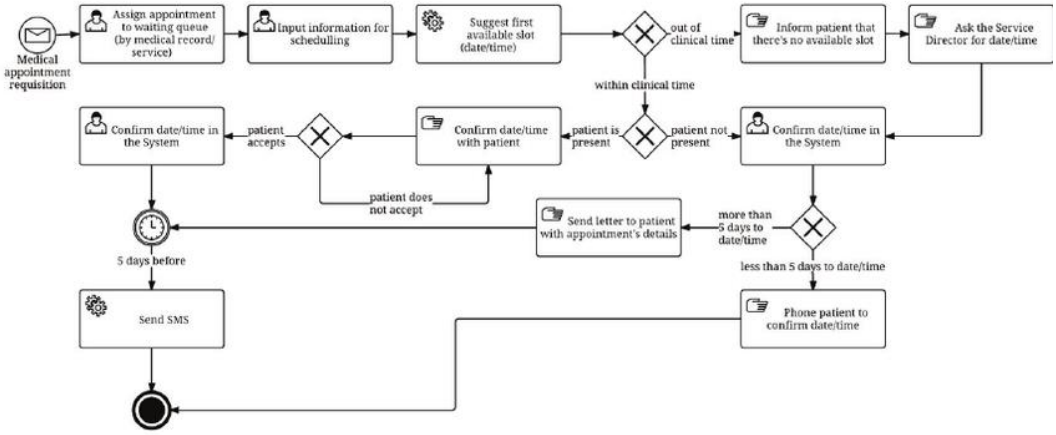

Figure 1: Medical Appointment Scheduling Process (Rijo et al., 2015)

The availability of a service slot is determined by the intersection of the disposability of patient and institution, which is further influenced by type and extend of care the patient requires and respective capacities of the facility. This information needs to be obtained by the institution's personnel. Accordingly, a date for consultation is scheduled; usually by use of an appointment management system that is integrated with the patient data management system (containing information such as patient identification, vital care parameters). Medical institutions usually have an average duration for the different treatments they offer and allocate their schedule on this basis (as discovered in the pre-study, **see 4.1.**). However, due to the unpredictable nature of health and patient behavior, these times are not always met precisely. This also includes the common occurrence of "no-shows", which are people that do not show up at the agreed appointment without notice. Medical care facilities therefore often invest extra time to send out several reminders to patients once a date is set. To avoid idle time and associated costs, medical care intuitions also frequently engage in overbooking (Rijo et al., 2015). These conditions, often lead to delays within the predefined appointment schedule, further resulting in waiting time for patients arriving in time for their consultation.

2. Research Background

2.1. Concept of innovation

The term innovation has various definitions. As stated in the Cambridge Dictionary (n.d.b), it represents as a new idea or method, or the use of such. According to the renowned economist Joseph Schumpeter (1934) "innovation is the commercial or

industrial application of something new – a new product, process or method of production; a new market or sources of supply; a new form of commercial business or financial organization". Barack Obama, former president of the United States said, "Innovation is the creation of something that improves the way we live our lives" (Hudson, 2014). However different each definition may be, there are three main components of innovation in which most of them coincide: Novelty, Problem Solving and Value creation. Novelty is the basic fundament of innovation; it is the quality of being new. Problem solving represents the origin and ultimate purpose of innovation as the motivation for change stems from the identification of an unmet demand. Lastly, the creation of value is the essential objective of any new method, product, or service. Various empirical and theoretical studies have proven the significance of innovation for long-term business success (Baker & Sinkula, 2002; Balkin et al., 2000; Enzing et al., 2011 all cited in Chatzoglou & Chatzoudes 2018). Companies need to engage in innovation in order to adapt to constant changes and developments within their entire business environment. Innovation enables them to stay relevant, create and uphold a competitive advantage, increase productivity and efficiency, maintain and extend their customer base and finally improve overall financial performance (Kylliäinen, 2019). In this context, innovation is not only an outcome, but rather also an ongoing process, that requires various resources and investments (Crossan & Apaydin, 2010 cited in Chatzoglou & Chatzoudes 2018).

2.1.1. Diffusion of innovation

Innovations offer the potential for substantially improving the performance of organizations. However, potential performance gains are highly dependent on the willingness of users to adopt and use the available innovation (Talukder, 2014). The Diffusion of Innovation theory by Eric Rogers (2003) seeks to explain why, how, and at what rate new ideas and technologies spread. The corresponding diffusion process is defined as the communication of the innovation to members of a social system through certain channels over time. In this context, a social system refers to a set of interconnected entities that are involved in a common problem-solving effort to achieve a common goal. These members may include individuals, informal groups, organizations, and/or subsystems (Rogers, 2003). From the moment of awareness until the eventual acceptance of a new idea, each individual is engaged in a decision innovation process (**see Figure 2**).

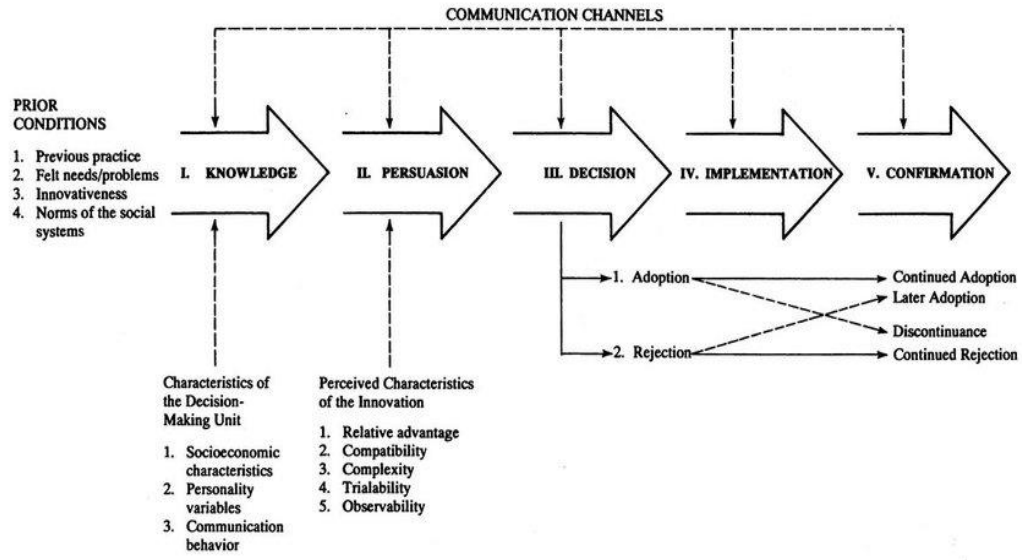

Figure 2: Decision innovation process (Rogers, 2003)

Awareness of a particular innovation creates curiosity and uncertainty about its consequences in the minds of potential adopters. Prospective benefits impel an individual to exert effort to learn more about the innovation. Once the uncertainty about the innovation's expected consequences is reduced to a tolerable level by such information-seeking activities, a decision for rejection or adoption can be made. By exploiting the novelty, further evaluative information about its effects is subsequently obtained (Rogers, 2003).

The relative speed with which an innovation is ultimately adopted by the individual or other unit of adoption is called adoption rate. It is usually measured by the length of time required for a certain percentage of the members of a system to adopt an innovation. Typically, this rate takes the form of an "S - curve" (**see Figure 3**) (Rogers, 2003).

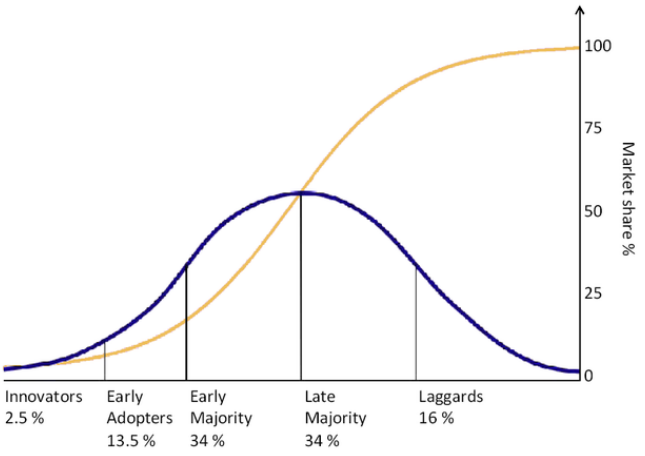

Figure 3: Diffusion of innovation (Rogers, 20013)

However, while some ideas diffuse relatively quickly, others have a slower rate of adoption, resulting varying slopes for different innovations' curves. According to Rogers (2003) there are five main characteristics of innovations that moderate their adoption ratio:

1. *Relative Advantage* - The degree to which an innovation is seen as better than the idea, program, or product it replaces.
2. *Compatibility* - How consistent the innovation is with the values, experiences, and needs of the potential adopters.
3. *Complexity* - How difficult the innovation is to understand and/or use.
4. *Trialability* - The extent to which the innovation can be tested or experimented with before a commitment to adopt is made.
5. *Observability* - The extent to which the innovation provides tangible results.

Accordingly, innovations that individuals perceive as having greater relative advantage, compatibility, trialability and observability, and less complexity are adopted more rapidly than others (La Morte, 2019; Rogers, 2003). When developing a new product or service, these characteristics need to be considered in order to ensure the fastest possible dissemination.

2.2. Theoretical Models for Technology Acceptance

With the rapid global progress of digitization, the adoption of innovations in the context of technology has become increasingly important. Research on individual acceptance and use of information technology (IT) is one of the most established and mature streams of information systems research (Venkatesh, Davis, & Morris, 2007). Research on technology adoption by groups and organizations has been conducted as well (e.g., Sarker & Valacich, 2010; Sarker et al., 2005; Sia et al., 2001), which holds the premise that before one can achieve desired outcomes, such as improvement in employee productivity and task performance in organizations, one must first use a technology. Researchers have developed and tested several competing models to explain and predict user acceptance and use of IT. One of the most noted models is the technology acceptance model (TAM) by Fred Davis (1989), an information systems theory mainly applicable for the organizational context (**See Figure 4**) (Venkatesch et al, 2016).

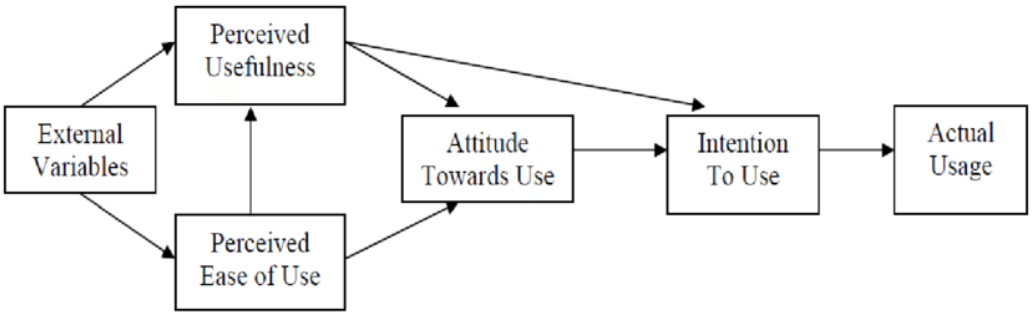

Figure 4: Technology Acceptance Model (Lai, 2017)

The model suggests that when a new technology is presented to potential users, several factors influence their decision about when and how they will use it. Actual system use is preceded by a individuals' behavioral intention to use the technology, which in turn is predicted by their attitude i.e., their general impression of the technology (Renaud & Van Biljon, 2008). This impression is further influenced by two key factors, the perceived usefulness (PU) and perceived ease-of-use (PEOU). The PU is defined by Fred Davis (1989) as "the degree to which a person believes that using a particular system would enhance his or her job performance". It means whether someone perceives that technology to be useful for what they want to do (Renaud & Van Biljon, 2008). PEOU is "the degree to which a person believes that using a particular system would be free from effort" (Davis, 1989). A technology that is expected to be easily operable and provide a great advantage for the successful execution of a certain task, will obtain a positive attitude in the minds of potential users (Renaud & Van Biljon, 2008).

Aiming for a more complete IT acceptance model, Venkatesh et al. (2003) integrated core elements from the TAM and seven other previously developed models and theories concerning technology adoption (including the theory of reasoned action (TRA), innovation diffusion theory (IDT), the theory of planned behavior (TPB), the model of PC utilization (MPCU), the motivational model (MM), and social cognitive theory (SCT)) and proposed the unified theory of acceptance and use of technology (UTAUT) (Al-Mamary et al., 2016). UTAUT follows the same fundamental structure as the TAM, but extends the factors influencing the behavioral intention to use a technology to four key constructs. In addition to Performance and Effort Expectancy (substitutes for PU and PEOU) the UTAUT identifies Social Influence and Facilitating Conditions. Facilitating

Conditions are also used as additional predictor for usage behavior, next to the Behavioral Intention. The model further includes person-specific items such as a potential users' gender, age, experience, and voluntariness to use as moderators of these predictors (**See Figure 5**) (Venkatesch et al, 2003).

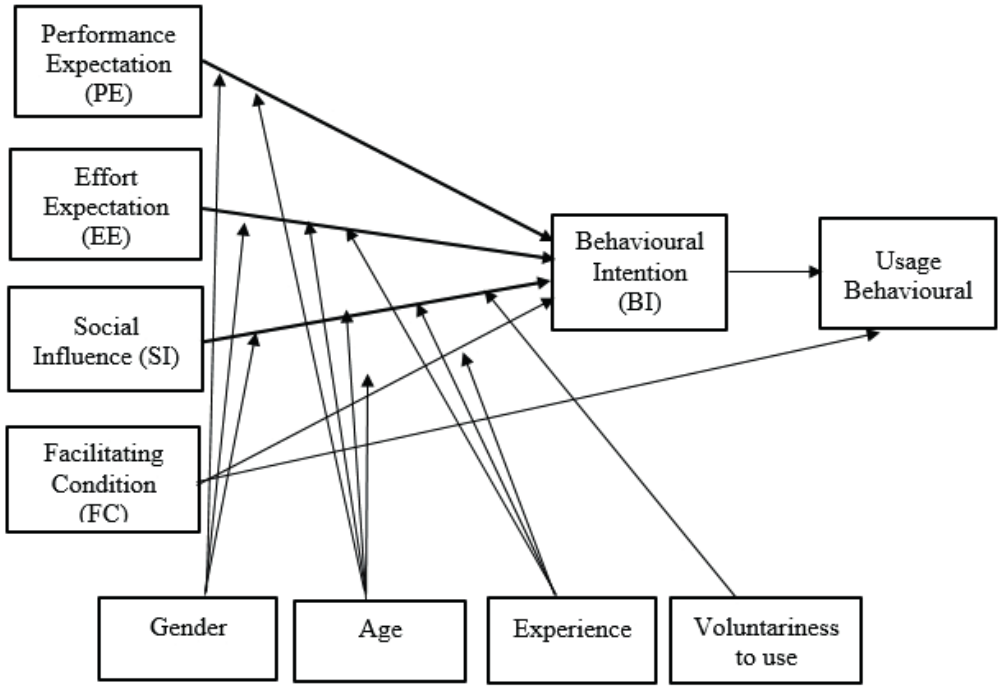

Figure 5: UTAUT model (Venkatesh et al., 2003)

Performance Expectancy and Effort Expectancy are similarly defined as PU and PEOU in the TAM, capturing the individual's expectancy for performance enhancement and usage effort of the technology. Social Influence refers to the degree to which a person or entity, that is deemed to be important to the individual believes that he/she should use the new system (Ayaz and Anartaş, 2020). Facilitating Conditions are defined as the extent to which an individual perceives that organizational and technical infrastructures required to use the intended system are available (Ghalandari, 2012 cited in Onaolapo and Oyewole, 2018).

Since being introduced, the UTAUT model has been tested extensively in various fields, analyzing users' acceptance of many different technologies and across many different industries (Apolinário-Hagen et al., 2019; Ayaz & Yanartaş, 2020; Sarfaraz, 2017). It is considered as the most prominent and comprehensive model in the stream of information technology adoption research with high explanatory power and robustness of the instruments regarding the key constructs (Park et al, 2007; Dulle & Minishi-Majanja, 2011). According to Venkatesh et al. (2003),

UTAUT is a useful tool for managers wanting to assess the likelihood of success for new technology introductions. Furthermore, it can be used to understand the drivers of adoption, in order to proactively design products/services that more successfully target user populations, and even persuade those who may be less inclined to adopt and use new systems.

2.3. Healthcare as a Service

Health care is "the organized provision of medical care to individuals or a community." (Oxford Dictionary, n.d.). As such it can be defined as a service, producing an essential intangible benefit, which satisfies an identified need through some form of exchange (NARA, n.d.). Medical care is delivered by health professionals and regarded as the maintenance of health through diagnosis, prevention, treatment, recovery, or cure of illness, disease, injury, and other physical and mental impairments in people (Atrash & Carpentier, 2012).

2.3.1. Service Quality

The quality of a specific service is defined through the customers' overall assessment of his/her experience (Ganguli and Roy, 2011, cited in Famiyeh et al. 2018) and represents the degree to which an entity satisfies its customer's needs (Batagan et al., 2009, cited in Famiyeh et al. 2018). The service experience thereby entails the entire customer journey along which a customer discovers, purchases, experiences and participates in a service (Spacey, 2018).

Having a direct and strong effect on customer satisfaction, service quality significantly influences various key indicators of a company's performance. Customer loyalty as well as repurchase intentions of existing and potential customers are positively affected by a highly perceived service quality, leading to increased profitability and market share (Kotler & Armstrong, 2007; Anderson & Sullivan, 1993; Brady and Cronin 2001 cited in Ghotbabadi et al., 2012). While a positive word of mouth, resulting from high perceived service quality, is a very powerful tool for attracting new customers, negative word of mouth can have a devastating impact on the credibility of organizations and their potential customer base. While research indicates that six times more people hear about negative than positive customer service experience, it simultaneously costs about four times more to attract new customers (Technical Assistance Research Project cited in Ghobadian et al., 1994). As a result, service quality is considered a critical determinant of any

organizations competitiveness and correspondingly authoritative for service companies, for which the provision of services is not just an additional component of their offering, but their core business.

2.3.2. Health care quality

Health care quality is a broad term that encompasses many aspects of patient care. It is defined as the degree to which health care services for individuals and populations increase the likelihood of desired health outcomes (WHO, n.d.). Seen in a business context, the patient takes on the role of the customer while the medical care provider replaces the company (Prakash, 2010). A handful of analytic frameworks for quality assessment have guided measure development initiatives in the public and private sectors. One of the most influential is the framework put forth by the Institute of Medicine (IOM), which includes the following six domains to measure and describe quality of care in health (Institute of Management, 2001):

1) *Safe* – Avoiding harm to patients from the care that is intended to help them.
2) *Effective* – Providing services based on scientific knowledge to all who could benefit and refraining from providing services to those not likely to benefit (avoiding underuse and misuse, respectively).
3) *Patient-centered* – Providing care that is respectful of and responsive to individual patient preferences, needs, and values and ensuring that patient values guide all clinical decisions.
4) *Timely* – Reducing waits and sometimes harmful delays for both those who receive and those who give care.
5) *Efficient* – Avoiding waste, including waste of equipment, supplies, ideas, and energy.
6) *Equitable* – Providing care that does not vary in quality because of personal characteristics such as gender, ethnicity, geographic location, and socioeconomic status.

According to Shi and Singh (2013), there are two different levels for the assessment of health care quality: that of the populations (macro-level) and that of the individual patient (micro-level). At the macro-level, assessments of health care quality include indicators such as infant mortality rates, incidence, life expectancy

and prevalence of certain health conditions. At the micro-level, assessment focuses on services at the point of delivery and its subsequent effects.

When striving for patient-centered care, understanding patient experience is essential. In reference to the previously defined service experience, it comprises the range of interactions that patients have with the respective health care provider, including their care from doctors and staff in hospitals, physician practices, and other health care facilities (AHRQ, 2021). By analyzing various aspects of patient experience, one can assess the extent to which patients are receiving care that is responsive to individual patient preferences, values and needs. Substantial evidence indicates a positive association between various aspects of patient experience, such as good communication between providers and patients, and several important health care outcomes, including better clinical results, patient adherence to medical advice, lower utilization of unnecessary health care services and improved patient safety practices (AHRQ, 2021).

2.4. Diffusion of innovation within the health care sector

The dynamics that govern the adoption of new medical- and information technologies in the health care industry are very complex. There are two main aspects to consider: 1) The unit of adoption is not the individual but rather a team, department, or organization 2) the unique nature of the health care industry.

For individuals, innovation diffusion occurs mainly through simple imitation, which may be influenced by, but is strictly speaking not dependent on, the decisions of others. However, the adoption decision within an organization will likely require various changes in structures or ways of working, which leaves the adoption decision of an individual within an organization rarely independent of others. It can be contingent (dependent on a decision made by another person within the organization), collective (the individual has a "vote" but must ultimately defer to the decision of a group) or authoritative (the individual is directed whether or not to adopt the innovation) (Rogers, 1995 cited in Greenhalgh et al., 2004). Authoritative decisions (e.g., when adoption by individuals is made mandatory) may determine initial adoption by individuals, but also carry the risk that the innovation will not be successfully implemented and routinized in the long run due to lack of self-belief (Rogers,1995 cited in Greenhalgh et al., 2004).

In connection with this, it is not only the characteristic features of the individual (e.g., needs, motivation, skill), but additionally or even more so the characteristics of the organization that influence the likelihood of the successful assimilation of an innovation (i.e., adopted by all relevant individuals and incorporated into "business as usual"). This includes (1) the structural and cultural features of the organization (system antecedents) and (2) the extent of existing will and readiness for innovation (system readiness) (Greenhalgh, 2004).

(1) *System antecedents for Innovation* include *structural determinants*, i.e., size, resources, functional differentiation, and administrative intensity; the organization's *absorptive capacity for new knowledge*, i.e., the ability to capture and interpret new knowledge, to link it with its own existing knowledge base and to put it to appropriate use; and the *receptive context for change*, including properties such as strong leadership, clear strategic vision, a climate conducive to experimentation and risk taking ((Anderson & West 1998; Barnsley et al., 1998; Dopson et al., 2002; Ferlie et al., 2001; Gosling, et al., 2003; Newton et al., 2003; Nystrom et al., 2002; Pettigrew & McKee 1992; Van de Ven et al. 1999 all cited in Greenhalgh, 2004).

(2) An organization's *Readiness for Innovation* can be assessed along three different elements that have a positive impact on the diffusion of innovation: The *tension for change*, i.e., the perception of staff, whether the current situation is intolerable; the degree of *"innovation – system fit"*, i.e., the innovations compatibility with existing values, strategies, and supporting technologies; and the *comprehensible assessment of the innovations' implications* (Gustafson et al., 2003; Rogers, 1995 all cited in Greenhalgh, 2004).

Returning to the previously mentioned dependence of the individual decision-maker within an organization, it is crucial to identify the number of stakeholders which potentially do affect and are affected by the technology adoption decision. Regarding health care service organizations, once a physician decides to use a new device or technology, he/she must often consider not only the impact on the patient and the procedure but also what it means for reimbursement, health care policy, and

the organization in which he/she is working (Cain & Mittman, 2002). A short list of stakeholders involved in a technology adoption decision are:

1) The policy makers and regulators who evaluate the safety and efficacy of the technology.
2) The payer, such as insurance companies or private practice owners, who decides whether payment will be made for use of the technology.
3) The provider organization (in the form of physicians and hospitals) that must decide whether to provide the technology and then also get the proper training and education to use it appropriately.
4) The patient who must know enough about the technology to give consent for its use.
5) The vendor company that researches, develops, and sells the technology.

For any decision of innovation adoption, multiple if not all these groups need to be considered. For example, when considering the *Relative Advantage* of an innovation (referring the five characteristics defined by Rogers (2003), in **2.1.1**) it is often only indirectly related to the decision maker. Many innovations within health care are concerning treatment methods or technologies that primarily serve the benefit of the patient. Although this is an important aspect to the physician, he/she must place it in proportion to his/her own advantage and assess whether it qualifies for reimbursement or can otherwise generate an economic benefit. When assessing *Complexity*, it is not just the ease of use for the physician that is important, but whether the innovation can be integrated into the existing infrastructure of the organization and whether those employees affected by it have the necessary skills to operate it. Therefore, in order to sufficiently explain the adoption and assimilation of complex innovations in organizations, the five "standard" attributes by Rogers need to be extended by another five characteristics (Greenhalgh, 2004):

1) *Fuzzy Boundaries*: The extent to which the "soft periphery" (the organizational structures and systems required for the full implementation of the innovation) is adaptable (Denis et al., 2002 cited in Greenhalgh, 2004). Also relating to "innovation – system fit" mentioned before.

2) *Risk*: The degree to which the outcome of an innovation is uncertain (Meyer & Goes, 1988; Meyer et al. 1997 all cited in Greenhalgh, 2004). This factor is especially important in the health care field because outcomes often relate to a person's physical health.
3) *Task Issues*: The degree to which an innovation is relevant to the execution of the intended user's work and improves task performance (Yetton et al., 1999 cited in Greenhalgh, 2004).
4) *Knowledge required to use it*: The extent to which the knowledge required for the innovation's use can be codified and transferred from one context to another. (Adler et al., 2003; Aubert & Hamel, 2001; O'Neill et al., 2002 all cited in Greenhalgh, 2004).
5) *Augmentation and support:* The scope of enhancements and services included with the adoption of the new technology (e.g., training, with customization, and a help desk) (Aubert & Hamel, 2001 all cited in Greenhalgh, 2004).

An overview of the complex structure that needs to be considered for the diffusion of innovations within health service organizations is shown in **Figure 6**.

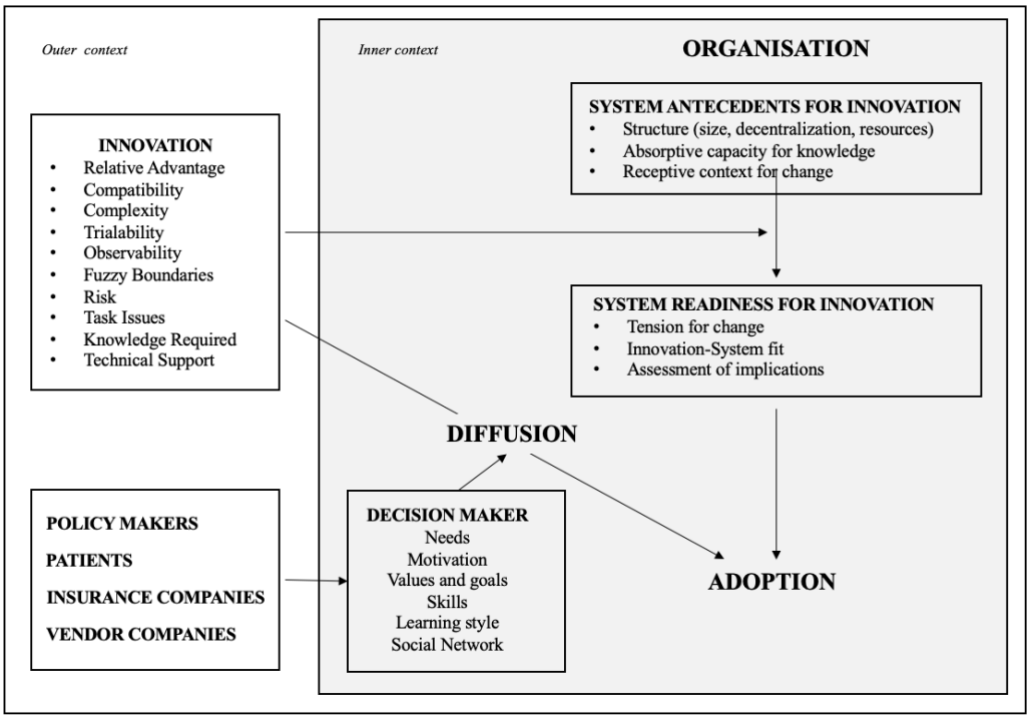

Figure 6: Innovation Diffusion within Health Service Organizations (Own representation based on Greenhalgh, 2004)

3. Conceptual Framework

To analyze and further investigate primary care physicians' attitudes regarding innovations in the context of appointment management, the UTAUT is used as basic framework. As before mentioned, the model has been extensively tested in various fields of study and therefore qualifies for the analysis in this context as well. For an accurate understanding of the underlying decision-making process, it is adjusted according to the feasible scope and objective of this research (See **Figure 7**).

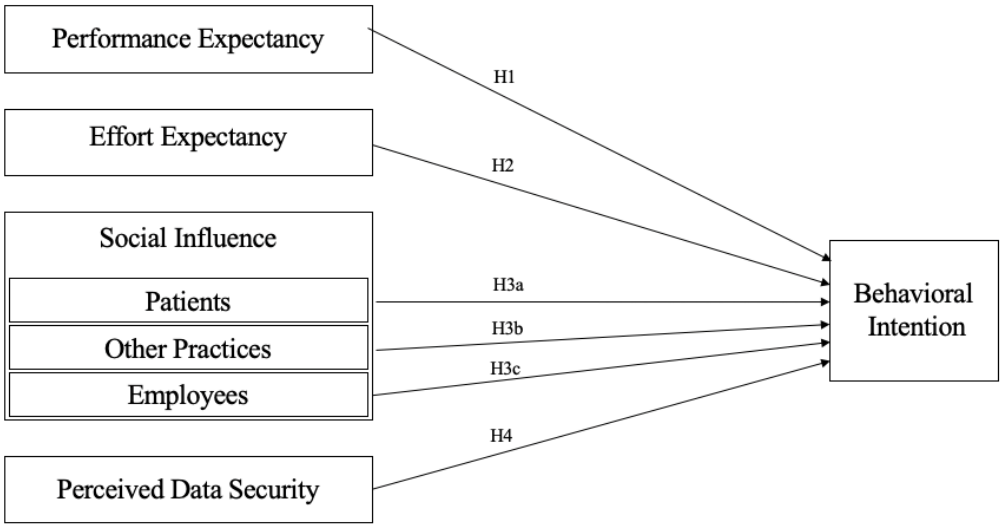

Figure 7: Conceptual Framework (Own representation)

Based on review of previous research on technology acceptance in the field of medical care, the focus for this research lies on performance expectancy (PE), effort expectancy (EE) and social influence as influencing constructs of the physicians' usage intention. In the following, each of these universal (technology acceptance) predictors is defined according to the object of study. Social influence is thereby divided into three different groups, considering the influence of patients (PI), of competing practices (CI) and the employees' influence (EI). Perceived Data Security (DS) is added as additional contextual predictor. Since the focus of study lies on understanding the composition of a physician's attitude towards a new technology, the actual usage behavior will be omitted. Facilitating conditions and person-specific moderators will not be considered as well.

3.1. Performance expectancy

Following the definition by Venkatesh et al. (2003) and considering the context of this study, PE is defined as the degree to which a physician believes that his/her job performance will be increased by the use of the proposed technology. Job performance hereby refers to the quality as a "care giver", considering the six domains of health care quality defined by the IOM (2001). Since the proposed innovation aims to improve the evidentiary problem of patient waiting times, *patient orientation*, *timeliness*, and *efficiency* are directly positively affected, resulting in a higher health care quality, which equates to better physician performance. Therefore, the proposed hypothesis is:

H1: Performance expectancy has a positive effect on the behavioral intention of physicians to use the technology.

3.2. Effort expectancy

EE expresses the degree of convenience regarding the use of the system (Venkatesh et al. (2003)). Relating to the diffusion of innovations within health service organizations (see **2.4**), this includes the direct operability of the system, the easiness of introducing staff and colleagues to its operation (*Knowledge required to use)* and the ability to integrate the technology with existing systems and into daily work processes (*Fuzzy Boundaries*). If the expectation of the necessary effort to introduce and install an innovation is very high (high *Complexity*), the behavioral intention is generally decreasing (Venkatesh et al., 2003; Roger, 2003). This leads to the following hypothesis regarding the influence of EE on physicians' usage intentions:

H2: Effort expectancy will have a negative effect on the behavioral intention of physicians to use the technology.

3.3. Social Influence

The Social Influence (SI) construct contains the degree to which individuals/entities of relative importance to the physician believe that he/she should implement the new technology (Venkatesh et al., 2003). Considering the model in **2.4**. this includes patients, employees, policy makers and insurance companies. Since the proposed innovation does not concern a new treatment technology but "only" the

appointment management, the latter two are not considered as social influencers in this context. In the field of health care, patients are equivalent to the physician's "customers", considered as “buyer of health services”, and therefore target object of their activities (Prakash, 2010). As such, their opinion is crucial and of the utmost importance regarding any innovation that is introduced. Referring to the appointment management process outlined in **1.3.**, it is the practice staff that is predominantly responsible for the appointment management and related patient contact. Therefore, their opinion is also assumed to have a valid effect on the physician’s intention for adoption. Furthermore, following the general structure of any business environment, competitors were included as influencing group as well. In the context of this study, this refers to outpatient practices that belong to the same medical specialty and/or are in the immediate geographic vicinity of the respondent's practice. It is not their opinion in particular, but rather their expected future actions that can be derived from it, which influences the intention of the physicians (as discovered in the pre-study). The resulting hypotheses are as follows:

H3a: The social influence of patients will have a positive effect on the behavioral intention of physicians to use the technology.

H3b: The social influence of competing practices will have a positive effect on the behavioral intention of physicians to use the technology.

H3c: The social influence of practice staff will have a positive effect on the behavioral intention of physicians to use the technology.

3.4. Perceived data security

An important attribute for the distribution of any innovation in the medical field is the associated *Risk* (**see 2.4.**). Although technology relating to the appointment management of a medical practice, does not affect the patient’s physical well-being directly (not a new “treatment technology”), there is still some risk to consider concerning, the patient data, that is involved in the process. Information about a person's health condition is a very special type of personal data and therefore particularly subject to data protection. The correct and secure handling of such

sensitive information has therefore always been essential for any institution within the health care sector. The increased use of IT has heightened the delicacy, complexity, and importance of data privacy in all areas of business. In addition, the introduction of the new EU General Data Protection Regulation (GDPR) in 2018 brought far-reaching changes for all types of organization, with significantly stricter requirements and consequences for non-compliance (GDPR.EU, n.d.). Therefore, for the introduction of new technologies, data protection plays a very critical role for medical facilities and needs to be included in the acceptance model for this study. The resulting Perceived Data Security (DS) construct is defined as the degree to which a physician believes that patient data will be safe from unauthorized access of externals when using the new technology. It can be assumed that technologies that are expected to have a high level of security of the data exchanged or associated with them, will trigger a higher intention to use them. This leads to the following hypothesis:

H4: Perceived data security will have a positive effect on the behavioral intention of physicians to use the technology.

4. Methodology

To answer the research questions, and consequently the before presented hypotheses, a quantitative research approach was used. Through a questionnaire survey, empirical data was collected from physicians working within an outpatient primary care unit (medical practice). The survey was based on the scenario-testing-method and related to a fictitious but realistic innovation. Prior to the construction of the corresponding questionnaire, a pre-study was conducted in form of several in-depths interviews. Furthermore, a pre-test was carried out with the final draft of the questionnaire to validate the study design.

4.1. Pre study

To gain a better understanding of appointment management within medical practices, the basic attitudes of physicians regarding new technologies, related influencing factors, and to confirm or refute initial assumptions, five in-depths interviews with German outpatient physicians were executed. Three of the interviewees worked in a general medical practice, one in a neurological practice,

and one in an orthopedic practice. The knowledge gained from these interviews enabled the development of a more accurate and targeted questionnaire, including the design of a suitable scenario. For practices that operated in a medical field that involved more uncertainty, potential urgent care patients, and higher patient frequency (i.e., general practitioners), the problem of patient wait time appeared to be more pressing. None of the respondents indicated that online appointment booking is offered in the practice in which he/she is working but only the traditional channels (telephone, on-site, fax). Perhaps the most surprising finding, however, concerned the relationship between physicians and patients' concerns for waiting time. Either the physicians did not perceive waiting times as an acute issue for patients or they acknowledged the problem but didn't believe it required any special action and simply was to be accepted. They confirmed this to be certainly related to the awareness of their "position of power", based on the imbalance of supply and demand within health care. Based on this, the previously made hypothesis regarding the influence of patients on physicians' intention (H3a) was modified as follows:

H3a: The social influence of patients <u>will not have an effect</u> on the behavioral intention of physicians to use the technology.

4.2. Quantitative research

For the analysis corresponding to the defined research objective, a scenario-based online survey experiment was chosen. The option of data collection by means of a field study was discarded due to time constraints, the extensive expenses required, and the difficulty of finding a suitable setting.

A questionnaire survey method enables the collection of a variety of data, including the beliefs, opinions, attributes, and behavior of the respondents (Hank et al., 2009). The use of an electronic questionnaire further has the advantages that data can be collected from a large sample in a short amount of time, at zero cost. Distribution and response are thereby completely independent of time and location of the respondent, and addressing a specific audience is rather easy. Furthermore, due to the absence of the interviewer, associated biases and errors are eliminated (Malhotra & Birks, 2007). With the assistance of various free survey platforms, online questionnaires are also rather easy to implement and customize. For this

study, the questionnaire was created with the online survey tool Qualtrics. Finally, the possibility of importing the respective results directly into data analysis software makes an electronic questionnaire easier to process and statistically analyze.

The additionally used method of scenario testing aims to identify the participants' decision rules using their response to a specific scenario i.e., a description of possible actions or sequence of events in the future (Cambridge Dictionary, n.d.c). When asked directly about their probable behavior, respondents are often unable or unwilling to answer correctly (Malhotra & Birks, 2007). These types of response biases are averted when using experimentally based scenarios (Smith & Bolton, 1998). It enables researchers to examine the true causal relationships between variables while controlling for obscuring variables (Calder et al., 1981). The integration of the scenario testing method into an electronic questionnaire survey, therefore, seems the most suitable for the scope of this study. However, it is crucial that the scenarios developed are plausible and consistent, which includes the use of experiences similar to those encountered in the field, to simulate reality as closely as possible (Kim & Jang, 2014).

4.2.1. Questionnaire design

The questionnaire included 25 questions and was composed of four different sections: 1) General information, 2) Assessment of the issue of patients waiting times, 3) Concept testing and 4) Demographics. Before the first section of questions, respondents were introduced to the purpose of the survey through a small preface text. It gave an estimate of the time required and clarified the aim of the study as to collect information about their appointment scheduling process and their attitude towards a potential new technology. Furthermore, participants were reassured that all the information provided is going to be kept confidential to obtain honest and credible results.

Section number one included questions about the medical specialty of the respondents' workplace/practice, patient frequency and appointment management. The questions in the second section aimed to define the degree to which patient wait time was an issue within this practice, including average patient waiting times, scheduled treatment time, occurrence of delays, perceived effects on patients and

practice. Section number three included the scenario description and corresponding questions for the measurement of the constructs related to the conceptual framework of the study (See **4.2.2**.). The final section was made of demographic questions such as practice location, profession, gender, and age. Information on occupation and place of residence, functioned as screening questions to ensure that participants qualified as part of the target group. The complete questionnaire and survey flow can be found in **Appendix 1**.

By using structured closed-response questions exclusively, with an adequate use of language, respondents were able to answer the questions with minimal effort (Malhotra & Birks, 2007). Questions regarding the causes of waiting times, and the effects on practice and patients, were each assessed using a set of different items rated on a five-point Likert scale. Depending on the object of question (consent vs frequency estimation), these were coded as 1 = "Strongly Disagree" or "Never" and 5 = "Strongly Agree" or "Always". For questions that required numerical estimates such as patient frequency, average patient waiting time and average scheduled treatment time, slider scales were used, which enabled the inclusion of a more extensive range of answers while maintaining convenience for respondents.

4.2.2. Scenario design and operationalization of constructs

To test the conceptual research framework of this study, respondents were presented with a concept-related scenario and subsequently asked questions related to each of the respective components (PE, EE, SI, DS and BI). For the development of an adequate scenario, existing solution concepts for similar queue management issues from the area of food delivery services were applied to the medical appointment management of medical practices. The insights gained from the pre-study, assisted in transforming these concepts as realistically as possible into the usual work environment of medical practices. The resulting scenario was a hypothetical app through which the patient's appearance was managed, in terms of real-time order fulfillment. The app, its functionalities and workflows associated with it were explained in a detailed descriptive text. The implementation of vignettes to describe prototypical or exemplary services in this research field is well established and has been applied in various other studies (Apolinário-Hagen et al., 2019). In the sense of storytelling and comprehensibility, the scenario was built

around a specific character representing the average patient. Furthermore, for a better understanding, the text was accompanied by images illustrating the user interface (See **Appendix 1**). Participants were instructed to imagine which expectations they would have regarding this fictional app and answer the subsequent questions accordingly. Following the scenario and construct related questions, a control question comprised of three different items was included to validate the scenario in terms of realism, comprehensibility, and answerability.

In devising a useful measurement instrument for the conceptual model and to assure validity of the research, items and scales used to measure the respective constructs were adapted from previous studies. The main basis here are the survey questionnaires developed within the original studies of the TAM by Venkatesh & Davis (2000) and the UTAUT by Venkatesh et al. (2003). Both studies have been replicated and widely used in other studies, providing evidence of the reliability and validity of their instrument. They were lightly adapted to the context of this study based on face validity. **Table 1** shows a complete overview of the contents of the original questionnaires and the items used in this study.

Table 1: Operationalization of constructs

Original Questionnaire TAM (Venkatesh & Davis, 2000)	**Original Questionnaire UTAUT** (Venkatesh et al., 2003)	**Items used in this study**
Perceived Usefulness	**Performance Expectancy**	**Performance Expectancy**
Using the system improves my performance in my job.	Using the system increases my productivity.	This service will improve my work performance. (PE1)
Using the system in my job increases my productivity.	Using the system enables me to accomplish tasks more quickly.	This service will increase my productivity. (PE2)
Using the system enhances my effectiveness in my job.	I would find this system useful in my job.	This service will enhance my effectiveness in my work. (PE3)
I find the system to be useful in my job.	If I use this system, I will increase my chances of getting a raise.	This service will be useful for my work. (PE4)
		This service will increase the quality of care I provide to my patients. (PE5)

Perceived Ease of Use My interaction with the system is clear and understandable. Interaction with the system does not require a lot of my mental effort. I find the system to be easy to use. I find it easy to get the system to do what I want it to do.	**Effort Expectancy** My interaction with the system would be clear and understandable. It would be easy for me to become skillful at using the system. I would find the system easy to use. Learning to operate the system is easy for me.	**Effort Expectancy** My interaction with the system is clear and understandable. (EE1) Interaction with the system will not require a lot of my mental effort. (EE2) The system will be easy to use. (EE3) This service can be easily integrated in the practice processes. (EE4) I can easily provide the resources needed for the use of this service. (EE5) The resources needed for the implementation of this service are minor. (EE6) I can easily convince my employees/ co-workers to use this service. (EE7)
Subjective norm People who influence my behavior think that I should use the system. People who are important to me think that I should use the system.	**Social Influence** People who influence my behavior think that I should use the system People who are important to me think that I should use the system The senior management of this business has been helpful in the use of this system In general, the organization has supported the use of the system.	**Social Influence** My patients would like this service. (PI1) My patients would want this service to be used at my practice. (PI2) My patients would switch to another practice if they would offer this service. (PI3) Other practices, of the same medical specialty as mine, would be interested in this service. (CI1) Other practices might implement a service like this soon. (CI2) My employees/ co-workers would like this service. (EI1) My employees/ co-workers would want this service to be used at my practice. (EI2)
Intention to Use Assuming I have access to the system, I intend to use it. Given that I have access to the system, I predict that I would use it.	**Behavioral Intention** I intend to use the system in the next <n> months. I predict I would use the system in the next <n> months. I plan to use the system in the next <n> months.	**Behavioral Intention** *Assuming that such a system now exists…* I would like to implement a system like this. (BI1) I will definitely implement a system like this in the future. (BI2) I will consider implementing a system like this. (BI3)

A crucial difference of this research is the action reference. While most studies refer to actual usage behavior, the survey of this study is subject to the premise of hypothetical usage. The overall wording has been adjusted accordingly. The measurement set for PU was extend by one item, to include the particular meaning of performance in the context of health care, defined as health care quality through IOM (PE5). This construct was thus assigned five items. For the EE construct, in addition to individual usability, the integration into practice processes was also incorporated (EE 4, EE7), as well as the necessary resources a practice would have to provide (EE5, EE6; relating to the *system antecedents* for innovation in **2.4.**), resulting in seven statements overall. SI is measured through two items in the original survey design of the TAM. In this study, separate constructs were formed for the different relevance groups (PI, EI, CI). Accordingly, two items were defined per group. In reference to the insights of the pre-study, questions on patient influence were expanded by one additional item to capture physicians' concern about losing patients by not adapting a new technology. The item set relating to BI has been adjusted in wording only and included three statements in total. Since DS is a completely novel factor, it could not be derived directly from the original questionnaires. Here, reference was made primarily to studies in the field of mobile banking and the therein often examined constructs of "Trust" and "Risk Perception", since the data processed in mobile banking is similarly sensitive to patient data. Three items were used for the measurement of this factor (**Table 2**)

Table 2: Operationalization of Data Security Expectancy construct

Internet Banking Adoption study (Foon & Fah, 2011)	**Adoption of mobile banking** (Sarfaraz, 2017)	**Items used in this study**
Trust	**Risk perception**	**Data Security Expectancy**
Trust I trust in the ability of an internet banking to protect my privacy and personal information	*When using mobile banking…*	*I believe that it is technically possible to design the app in such a way that…*
I believe no money will be lost in unauthorized electronic fund transfer	I believe my information is kept confidential	... the personal information of my patients is safe. (DS1)
Other people cannot view my bank account information	I believe my transactions are secured	… unauthorized people will not be able to gain access to my patients' personal information. (DS2)
Internet banking has enough specialists to detect fraud and information theft	I believe my privacy would not be divulged	... unauthorized access will be detected immediately (e.g., cyberattack). (DS3)

In total, 25 items were queried, which were all rated on a five-point Likert- scale anchored by 1 (“Strongly disagree”) to 5 (“Strongly agree”). Through usage of balanced scales with five categories, including a neutral scale response, the effect of forcing the respondents into one direction was avoided.

4.2.3. Pre-Test

To ensure a frictionless flow of the survey, plausibility, and consistency of the scenario, and to reduce any type of misinterpretations, the questionnaire was pre-tested with six participants. These included two physicians working in a general medical practice, one dentist, and three respondents outside the target group. The resulting remarks were mostly related to minimal spelling errors and ambiguous wording, which were directly transposed. All respondents found the scenario to be very understandable and the participants from the medical field confirmed the realism of the scenario. The scenario description had an enormous length, which added a significant amount of time to the survey and posed an additional barrier to attracting participants to complete. However, the proper understanding of the scenario was prioritized and therefore the length was not adjusted.

4.2.4. Study sample and recruitment

In order to obtain more conclusive results, the study focused solely on the German market. Using convenience sampling, an online sample of physicians working within outpatient clinics was recruited via e-mail and personal contacts of the researcher. Through use of the online survey software Qualtrics, responses were recorded directly and made available for analysis. A summary of aggregated findings was offered as compensation for participation. In case of having questions or any feedback, participants were given the e-mail contact of the researcher. Although the target population concerned Germany, the entire questionnaire was available in German as well as in English, to prevent possible language barriers due to international backgrounds.

In order not to further limit the already highly targeted pool of potential participants, no particular medical specialty was imposed as a condition of participation. Because of the very specific target group, neither regular social networks nor online services for the commercial generation of subscribers (e.g., Amazon MTurk) could be utilized. In 2020, 161400 physicians were recorded in outpatient practice (Bundesärztekammer, 2021). Based on this and considering sample sizes of other

academic studies that target a much larger/general population, a sample of 50 valid responses was aimed at as a sufficient response. The questionnaire was distributed over a period of four weeks. The average completion time was 10 to 15 minutes.

5. Data Analysis

The data collected was analyzed using SPSS Statistics, a software package used for various types of statistical data analysis. Before analyzing the results, the data set was subjected to a so-called "cleaning process", which involves the detection and correction or removal of incomplete duplicate, or incorrect, data (Malhotra & Birks, 2007). A total of 68 responses were recorded, of which 18 had to be excluded because the survey was either not fully completed or the completion time did not allow for a meaningful response. Thus, the final dataset consisted of 50 respondents. For an initial summary of the collected data and generalization of information, descriptive statistical analysis was first performed. Additionally, before running the inferential analysis to test the proposed hypotheses, the quality of the measurements was checked regarding validity and reliability.

5.1. Descriptive statistical analysis

The participants of the cross-sectional study consisted of 50 physicians working in outpatient settings within Germany. 64 % of the respondents were female (32), 34% male (17) and one participant did not specify (2%). The majority of participants is working int the field of general medicine (68%), followed by 26 % from the dental field. Another 4% reported working in a practice that practiced both general and internal medicine. One participant stated to be working in an orthopedic practice. **Table 3** gives an overview of the medical practices' profiles regarding patient frequency, - age, and items of appointment management.

Table 3: Practice Profile

Category	**Mean**	**Range**	**SD**
Q2 Average number of patients treated at your practice per day	82.5	10 - 150	33.342
Q3 Average number of patients you treat per day	32.88	8 – 70	12.605
Q4 Average age of patients treated at your practice	53.44	35 - 75	7.324
Q5 How can appointments be booked at your practice (n/%)			
Telephone	50	100	
Fax	6	12.0	
Mail	38	76.0	
In person	50	100	
Online	6	12.0	

Q6 Time scheduled for treatment of patient	17.82	7 - 60	12.615
Q7 Do you schedule buffer time for treatment of patient?			
Yes	30	60	
No	20	40	
Q8 Buffer time scheduled per patient	4.77	2 - 15	2.459

The average number of patients treated daily within the respondents 'practice is 82.5, however, the values vary greatly (range 10-150). Regarding the channels offered for booking appointments, telephone and in-person are the most widely used means (100%). Online appointment scheduling and arrangements via fax are both equally low in prevalence (6%). An average of 17.82 min per patient is calculated into the appointment schedule. Extra buffer time is only scheduled in 30% of practices.

The second part of the questionnaire was investigating the perceived issue of patient waiting times. **Table 4** gives an overview of the respective survey results.

Table 4: Assessment of perceived issue of patient waiting time

Category	Mean	Range	SD
Q9 Can you always keep to your schedule?	3.28	2 - 4	.701
Q10 Reasons why			
Treatment takes longer	3.30	2 - 4	.647
Emergency patient	3.06	2 - 4	.550
Inefficiency in practice process	2.34	1 - 4	.658
Patient being late	2.60	2 - 4	.535
Q11 Average patient waiting time	14.86	3 – 31	6.227
Q12 Influence of patient waiting time on practice			
Doesn't affect at all	3.06	1 - 5	1.038
Is unavoidable	3.30	1 - 5	.931
Invest extra resources	2.72	1 - 5	1.031
Economic drawback	2.26	1 - 5	1.006
Q13 Influence of patient waiting time on patient			
Patients don't mind	3.40	1 - 5	.881
I if politely explain they understand	4.44	4 - 5	.501
Perceive it as unpleasant	3.12	1 - 5	.918
They enjoy it	2.46	1 - 4	.734
Perceive it as ineffective	3.02	1 - 5	.769
Q14 Have you ever taken any action against the issue?	N (%)		
Yes, I have	36 (72%)		
Haven't been able to find a useful measure	1 (2%)		
Wasn't possible	1 (2%)		
Wasn't necessary	12 (24%)		

The first thing to be noticed when inspecting these results is the central tendency of the values, which is a common bias for questionnaire surveys using Likert-Scales (Douven, 2018). Most average rating values range within 2.5 and 3.5 which makes a significant interpretation difficult. For a better assessment, the frequency distribution of the individual answers was therefore considered as well (**Appendix 2**). According to the results, most practices are meeting their predefined schedule about 50% of the time. The strongest reason for this seems to be unexpected longer duration of patient treatment, although all potential reasons are ranked quite similarly. On average patients must wait around 14.86 minutes until being examined, however, the responses vary widely (SD 6.227). According to the participants, neither the practices themselves nor the patients are too much affected by patient waiting time.

Table 5 shows the descriptive results for construct related questions; the problem of central-tendency bias is evident here as well.

Table 5: Descriptive analysis of constructs

Construct Items	**Mean**	**SD**	**Strongly disagree N (%)**	**Somewhat disagree N (%)**	**Neither agree nor disagree N (%)**	**Somewhat agree N (%)**	**Strongly agree N (%)**
PE	**2.48**						
PE1	2.42	.883	6 (12%)	23 (46%)	16 (32%)	4 (8%)	1 (2%)
PE2	2.46	.838	5 (10%)	22 (44%)	19 (38%)	3 (6%)	1 (2%)
PE3	2.34	.848	6 (12%)	26 (52%)	14 (28%)	3 (6%)	1 (2%)
PE4	2.86	.969	6 (12%)	8 (16%)	24 (48%)	11 (22%)	1 (2%)
PE5	2.34	1.042	8 (16%)	28 (56%)	5 (10%)	7 (14%)	2 (4%)
EE	**2.85**						
EE1	3.38	1.048	4 (8%)	4 (8%)	16 (32%)	21 (42%)	5 (10%)
EE2	3.36	1.025	3 (6%)	7 (14%)	13 (26%)	23 (46%)	4 (8%)
EE3	3.02	.979	4 (8%)	8 (16%)	24 (48%)	11 (22%)	3 (6%)
EE4	2.42	1.012	10 (20%)	17 (34%)	16 (32%)	6 (12%)	1 (2%)
EE5	2.76	1.061	6 (12%)	15 (30%)	16 (32%)	11 (22%)	2 (4%)
EE6	2.60	.969	7 (14%)	16 (32%)	17 (34%)	10 (20%)	0
EE7	2.44	.837	5 (10%)	23 (46%)	18 (36%)	3 (6%)	1 (2%)
PI	**2.73**						
PI1	3.10	.839	2 (4%)	6 (12%)	30 (60%)	9 (18%)	3 (6%)
PI2	3.00	.808	2 (4%)	9 (18%)	27 (54%)	11 (22%)	1 (2%)
PI3	2.10	.789	10 (20%)	27 (54%)	12 (24%)	0	1 (2%)
CI	**3.00**						
CI1	2.98	.742	2 (4%)	7 (14%)	32 (64%)	8 (16%)	1 (2%)
CI2	3.02	.685	1 (2%)	7 (14%)	33 (66%)	8 (16%)	1 (2%)
EI	**2.56**						
EI1	2.54	.862	4 (8%)	22 (44%)	18 (36%)	5 (10%)	1 (2%)
EI2	2.58	.835	3 (6%)	22 (44%)	19 (38%)	5 (10%)	1 (2%)

DS	**3.00**						
DS1	3.36	1.005	3 (6%)	7 (14%)	12 (24%)	25 (50%)	3 (6%)
DS2	2.90	.909	3 (6%)	12 (24%)	24 (48%)	9 (18%)	2 (4%)
DS3	2.76	.870	4 (8%)	13 (26%)	25 (50%)	7 (14%)	1 (2%)
BI	**2.60**						
BI1	2.54	.973	6 (12%)	20 (40%)	17 (34%)	5 (10%)	2 (4%)
BI2	2.38	.987	9 (18%)	21 (42%)	13 (26%)	6 (12%)	1 (2%)
BI3	2.88	.940	4 (8%)	11 (22%)	24 (48%)	9 (18%)	2 (4%)

Overall, the average ratings of constructs are very moderate, with a slight tendency toward the less agreeable side of the scale. The most significant item is PI3 (mean 2.10), indicating that most respondents are not concerned about losing patients to competitors who use the system. BI and PE were the factors with the lowest rating. 56% of physicians do not believe the use of the service would increase the quality of care they provide to their patients. DS and CI were the constructs with the relatively highest or rather "least lowest" rating.

Following the construct- and scenario-related questions, a set of three statements was used to assess the comprehensibility of the scenario, including realism, understandability and the ease of question answering regarding the scenario. The overview of the results in **Table 6** shows that although the values here are also rather moderate, there is a distinct tendency towards agreement.

Table 6: Assessments of scenario comprehensibility

Comprehensibility of scenario	**Mean**	**SD**	**Strongly disagree N (%)**	**Somewhat disagree N (%)**	**Neither agree nor disagree N (%)**	**Somewhat agree N (%)**	**Strongly agree N (%)**
Total	***3.77***						
Realistic	3.40	.926	1 (2%)	7 (14%)	18 (36%)	19 (38%)	5 (10%)
Easily understandable	4.04	.669	1 (2%)	0	4 (8%)	36 (72%)	9 (18%)
Easy to answer questions in regard to scenario	3.86	.808	0	5 (10%)	5 (10%)	32 (64%)	8 (16%)

5.2. Validation of measurements

The main objective of a questionnaire in research is to obtain relevant information in the most reliable and valid manner. Therefore, the consistency and accuracy of a questionnaire form a significant aspect of research methodology, referred to as reliability and validity (Taherdoost, 2016).

5.2.1. Reliability

Reliability relates to the stability and consistency of the measurement results. The most common approach for testing the reliability of Likert scale measurements is Cronbach's alpha (α). The alpha coefficient reflects the internal consistency of the scale, i.e., the degree of correlation between items (Collins, 2007). Its value varies between 0 and 1, with 0 indicating no relationship between items in a given scale and 1 indicating absolute internal consistency (Tavakol & Dennick 2011 cited in Mohajan, 2017). According to Cronbach (1951), alpha values above 0.7 are generally considered acceptable, above 0.8 are considered reasonably good, and above 0.9 are considered to reflect exceptional internal consistency. The results of the reliability analysis for the constructs of this study's questionnaire are shown in **Table 7**.

Table 7: Reliability statistics

Construct	**Number of items**	**Cronbach's Alpha**
PE	5	**0.897**
EE	7	**0.903**
PI	3	**0.726**
CI	2	**0.751**
EI	2	**0.924**
DS	3	**0.924**
BI	3	**0.901**

According to these results, the internal consistency of the subscale for all factors is satisfactory ($\alpha \geq 0.7$). Most of the constructs can even be considered as highly reliable with PE, EE, EI, DS, and BI all scoring a coefficient value above 0.89. The consistency of the measurement results of each variable can therefore be confirmed. As part of the reliability analysis using SPSS, the alpha coefficient for the entire scale is calculated again for each item as if that item were removed from the scale. Ideally, when an item is eliminated, the coefficient should decrease accordingly. This does not apply to the third item of the PI construct (PI). The analysis output indicates that if PI3 was removed, the alpha coefficient for PI would increase from **0.726** to **0.878 (See Appendix 3)**. Therefore, this item was excluded from further analysis.

5.2.2. Validity

The validity of a questionnaire explains how well the collected data covers the actual area of investigation, i.e., whether it measures what it was intended to (Ghauri and Gronhaug, 2005 cited in Taherdoost, 2016). The specific form of construct validity refers to the degree to which a concept or behavior representing a construct, has been successfully transformed to reflect reality, i.e., the operationalization. This includes convergent and discriminant validity. Whereas discriminant validity defines the extent to which latent variable A (construct A) differentiates from other latent variables (e.g., B, C, D), convergent validity refers to the degree to which two constructs that theoretically should be related, are in fact related (Fornell and Larcker, 1981). Correspondingly, for discriminant validity the relationship between measures from different constructs should be very low while for convergent validity item intercorrelations for all items that belong to the same constructs should be very high. Principal Component Analysis (PCA) will be used to assess both aspects of construct validity. PCA, is a statistical technique to reduce the dimensionality of a dataset, while preserving as much 'variability' (i.e. statistical information) as possible (Joliffe & Cadima, 2016). The Kaiser-Meyer-Olkin measure of sampling adequacy (KMO) and Bartlett's tests of sphericity are two tests that indicate the suitability of data for this kind of structure detection. While the KMO coefficient compares simple correlations and partial correlations between variables, the Bartlett's test examines the independence between variables. The results of these assessments are shown in **Table 8**.

Table 8: KMO and Bartlett's test

KMO measure of Sampling Adequacy		**.689**
Bartlett sphericity test	Approximate chi-Square	1295.251
	DF	276
	Significance	**<.001**

If the KMO coefficient exceeds a value of 0.5, the data is generally considered appropriate for factor analysis. The closer the value is to 1.0, the more suitable. Bartlett's sphericity test is based on the hypothesis that variances are equal (i.e., homogeneous) across groups, indicating that variables are unrelated and therefore unsuitable for structure detection. This hypothesis may be rejected if the value of

significance is low (less than 0.05). Given a KMO coefficient of 0.689 and a significance level of <0.001, the data of this study qualifies for PCA.

Table 9 shows the rotated component matrix. Varimax was used as rotation method and the number of factors was fixed to seven. Furthermore, all loadings below 0.5. were instructed to not be displayed in the component matrix. In order to satisfy the criteria of construct validity, all items of one construct should load on the same factor with a value above 0.5 (convergent validity) and simultaneously not load on any other factors (discriminant validity).

Table 9: Rotated component matrix

	Component						
	1	2	3	4	5	6	7
PE1			0,738				
PE2			0,814				
PE3			0,722				
PE4		0,531					
PE5		0,596					
EE1	0,565						
EE2					0,852		
EE3					0,848		
EE4			0,526				
EE5							0,768
EE6							0,682
EE7	0,660						
PI1		0,883					
PI2		0,813					
CI1						0,831	
CI2						0,773	
EI1	0,815						
EI2	0,832						
DS1				0,908			
DS2				0,891			
DS3				0,915			
BI1	0,547						
BI2	0,521						
BI3		0,731					

As you can see from **Table 9**, only PI, CI, EI and DS can fulfill these requirements. For PE, two out of five items (PE4, PE5) do not load on the same factor as the remaining items. The same applies for the BI construct, where only two out of three items load on the same factor. The items for EE are missing any pattern of construct validity since loading on four different factors. It must further be noted that BI and EI both load on the same factor. The construct validity of the study must therefore be classified as insufficient. The further analysis is being continued for all variables

nonetheless; however, this must be taken into account as a limitation in the evaluation of the results.

5.3. Inferential analysis

When reviewing various studies that were also constructed around the concept of UTAUT, different approaches to model and hypothesis testing were noted. The most widely used methods were confirmatory factor analysis (CFA) through structural equation modeling (SEM) and multiple regression analysis (MLR). CFA is a statistical procedure to determine the fit of data to the specific theoretical-derived model and reveal the relationships between observed variables and latent variables (Mueller & Hancock, 2001). MLR tests the effect of multiple independent variables (predictors) on one specific dependent variable (Malhotra & Birks, 2007). Although causal modeling through SEM would have been the preferred, more comprehensible method, the small sample size and model structure made it rather unsuitable for this study. According to Hair et al. (2011), the SEM, minimum sample size required for SEM should be higher than 10 times of the maximum number of inner or outer model paths directed at any latent variable in the model. Anne Boomsma (1982) even recommends a minimum sample size of 200. As this study only includes 50 participants, and the maximum number of model paths exceeds five, these requirements can't be met. Conclusively, due to its robustness and ability to analyze small sample sizes of data, MLR was selected as the analysis method for measuring the relationships between PE, EE, PI, CI, EI and DS and BI.

MLR underlies several assumptions, including the existence of a linear relationship between dependent and independent variables (linearity), residuals being normally distributed (normality), independent variables not to be highly correlated with each other (absence of multicollinearity) and the variance of error terms to be similar across values of the independent variables (homoscedasticity) (Statistics Solutions, n.d.). These assumptions are verified in the course of the following analysis. Both independent and depend variables within this study are measured on a nominal scale and therefore classified as categorical variable. However, the mean of all items related to each factor of the research model was computed to create seven combined variables (PE, EE, PI, CI, EI, DS, BI). For further analysis, these were treated as interval scaled.

First, Pearson correlation analysis was conducted to explore linear relationships between the independent and dependent variables. Respective results are displayed in **Table 10**.

Table 10: Pearson-correlation matrix

	PE	**EE**	**PI**	**CI**	**EI**	**DS**	**BI**
PE	1	.669	.611	.550	.585	.239	**.815**
		<.001	<.001	<.001	<.001	<.001	**<.001**
EE		1	.432	.462	.598	.377	**.632**
			.002	<.001	<.001	.007	**<.001**
PI			1	.370	.428	.176	**.693**
				.008	.002	.221	**<.001**
CI				1	.322	.227	**.615**
					.023	.112	**<.001**
EI					1	.019	**.674**
						.898	**<.001**
DS						1	**.250**
							.081
BI							1

The Pearson coefficient measures the linear correlation between two variables, where 0 indicates no correlation, 1 total positive correlation and −1 total negative correlation (Ratner, 2009). As we can see from **Table 10**, there is a significant relationship between performance expectancy ($r = 0.815$, $p < 0.01$), effort expectancy ($r = 0.632$, $p < 0.01$), patients' influence ($r = 0.693$, $p < 0.01$), influence of competing practices ($r = 0.615$, $p < 0.01$) and employees influence ($r = 0.674$, $p < 0.01$) with behavioral intention. Since DS just barely misses the 5% significance threshold ($r = 0.250$, $p < 0.081$), it is retained for further analysis as well.

Subsequently, MLR was performed in SPSS.

At first, the assumptions of normality and homoscedasticity can be verified by observing the P-P plot and the scatterplot of residuals (Statistics Solutions, n.d.). Both graphs can be found in **Appendix 4 and 5**. The P-P plot gives information about the normal distribution of the residuals. Normality can be confirmed if the points generally follow the diagonal line without strong deviations. In turn, for the detection of homoscedasticity, the scatter points within the plot of residuals must not have a pattern. Accordingly, both assumptions can be confirmed for this study.

The model summary of the MLR analysis is shown in **Table 11**. It contains several measures that determine how well the regression model fits the data.

Table 11: Model Summary

Model	**R**	**R^2**	**Adjusted R^2**	**Standard error of the estimate**
1	.901	.812	.786	.40866

Independent variables: DS, EI, CI, PI, EE, PE
Dependent variable: BI

R, the multiple correlation coefficient, is the linear correlation between the observed and model-predicted values of the dependent variable. A value of 0.901 indicates a strong relationship. The adjusted R^2 indicates the explanatory power of the regression model (Statistics Solutions, n.d.). Accordingly, 78.6% of the variation in the dependent variable (BI) can be explained by the independent variables (PE, EE, PI, CI, DI, and DS). The remaining 21.4% of variation are explained by other factors not considered in this study.

The analysis of variance (ANOVA) analysis examines the statistical significance of the correlations between the predictor constructs and the dependent construct (BI), thereby testing whether the overall regression model is a good fit for the data. It uses the F-test, which is based on the null hypothesis that the model explains zero variance in the dependent variable ($R^2 = 0$) (Statistics Solutions, n.d.)

Table 12: ANOVA of Multiple Linear Regression for Behavioral Intention

Model		**Sum of squares**	**DF**	**Mean square**	**F**	**Sig.**
1	Regression	31.041	6	5.174	30.979	<.001
	Residuals	7.181	43	.167		
	Total	38.222	49			

Independent variables: DS, EI, CI, PI, EE, PE
Dependent variable: BI

According to the results displayed in **Table 12**, the F-test classifies as highly significant with a p-value of <0.001. It can therefore be assumed that the model explains a significant amount of variance in the BI variable.

Finally, the coefficient table displays the multilinear regression estimates including the significance levels (**see Table 13**). MLR performs a t-test which null hypothesis is that the two variables (independent and dependent) are not linearly related (Statistics Solutions, n.d.).

Table 13: Multiple Linear Regression Coefficients

Model		Unstandardized Coefficients		Standardized			Collinearity Statistics	
		B	**Std. Error**	**Beta**	**t**	**Sig.**	**Tolerance**	**VIF**
1	Constant	-1.196	.355		-3.367	.002		
	PE	.416	.125	**.364**	3.319	.002	.363	**2.754**
	EE	-.033	.115	**-0.29**	-.284	.778	.410	**2.439**
	PI	.300	.096	**.264**	3.138	.003	.616	**1.624**
	CI	.304	.111	**.220**	2.735	.009	.675	**1.481**
	EI	.316	.098	**.293**	3.210	.003	.525	**1.906**
	DS	.073	.076	**.072**	.957	.344	.782	**1.279**

Dependent variable: BI

To begin with, the table provides indicators regarding multicollinearity. The variance inflation factor (VIF) measures the impact of collinearity among the variables in a regression model. It is anchored at 1 and has no upper limit. In general, VIF values that exceed 10 are considered as indications of multicollinearity (Hair et al., 1995). Since none of the VIF values for the predictor variables exceed 5, multicollinearity is not a concern in the regression model.

The regression table further indicates that four out of six independent variables have unique statistically significant contribution ($p < 0.05$) towards the behavioral intention of outpatient physicians to use the proposed technology including their performance expectancy (PE; $p = 0.002$), the influence of patients (PI; $p = 0.003$), competing practices (CI; $p = 0.009$), and employees (EI; $p = 0.003$). However, the expected effort (EE; $p = 0.778$) and perceived data security (DS; $p = 0.344$), were not found to have significant influence. The expectation regarding the potential performance increase through the use of the technology, has the greatest impact on physicians' intention to use the technology ($\beta = 0.364$), followed by the opinions of employees ($\beta = 0.293$), opinions of patients ($\beta = 0.264$) and potential actions of competing practices ($\beta = 0.220$).

Accordingly, the research hypotheses regarding PE (1), CI (3b) and EI (3c) can be accepted, while the hypotheses regarding EE (2), PI (3a) and DS (4) will have to be rejected. **Table 14** shows the summary of the results in relation to the defined research hypotheses.

Table 14: Summary of Results of Hypothesis Testing

Hypothesis		
H1	Performance expectancy has a positive effect on the behavioral intention of physicians to use the technology.	**Accepted**
H2	Effort expectancy will have a negative effect on the behavioral intention of physicians to use the technology.	**Rejected**
H3a	The social influence of patients will have a positive effect on the behavioral intention of physicians to use the technology.	**Rejected**
H3b	The social influence of competing practices will have a positive effect on the behavioral intention of physicians to use the technology.	**Accepted**
H3c	The social influence of practice staff will have a positive effect on the behavioral intention of physicians to use the technology.	**Accepted**
H4	Perceived data security will have a positive effect on the behavioral intention of physicians to use the technology.	**Rejected**

6. Conclusion and Discussion

The purpose of this research was to identify the decisive factors for the usage intention of primary care physicians regarding appointment management systems that are based on real-time mobile queueing. By means of secondary research and in-depth interviews, initial findings were collected on the underlying thought structures of physicians regarding the adaptation of new technologies, the perceived issue of waiting times and process flows of appointment management. Based on this and instructed by the UTAUT model, Performance Expectancy, Effort Expectancy, the Influence of Patients, Competing Practices, and Employees as well as the expected Data Security were defined as determining factors for testing and corresponding hypotheses for evaluation were established.

The statistical analysis performed identified only four of the six factors as having a significant influence on the behavioral intention of physicians. The factor generating the highest contribution is Performance Expectancy. This situation is supported by previous research, as many studies using the PE factor within the UTAUT model have found it to be the most powerful predictor for usage intention (Afonso et al., 2012; Kim et al., 2016; Kristiawan & Harisno, 2016; Mosweu et al., 2016; Nadlifatin, 2019; Sapio et al., 2010; Sharifian et al., 2014; Tosuntaş et al., 2015; Venkatesh et al., 2003; Wang & Shih, 2009 all cited in Ayaz & Yanartaş,

2020). Additionally, as increased PE can be directly related to gaining a *relative advantage* (relating to Rogers, 2003), it seems reasonable that it has such a significant impact on the physician's intention.

The opinion of the practice staff hast the second highest contribution on the physician's usage intention. This seems plausible, given that they are the ones who are primarily involved with appointment booking and the associated patient communication. If they are not convinced about the use of a new technology, it is of little value if the physician or patients are willing.

In third position is the Patient's Influence. Considering the significance of customer satisfaction for the success of a service organization, this relatively low ranking seems surprising. One possible explanation could be the lack of awareness among physicians for the actual extent of the issue for patients, which is reflected in the survey results for Q13 (**See Table 4**). Even more essential in this context, however, seems to be the disproportion of supply and demand within the sector of primary healthcare, and the resulting power position of physicians (Kassenärztliche Bundesvereinigung, n.d.). A commercial enterprise is required to constantly innovate in order to meet the changing demands of its customers and prevent to lose them. This position of influence, however, is missing within the patient-doctor relationship. An indication of this is also provided by the low availability of online appointment booking and the common agreement that "patients won't mind waiting as long as they receive a polite explanation" which were identified within descriptive analysis. This can further be related to the relatively low influence of competing practices (CI), which was identified as the weakest of the four significant influencing factors. Physicians do not have to be overly concerned about "running out of patients".

Another issue that needs to be considered in this regard as well, is the paradox relationship between the physician as decision-maker and the patient as primary subject of the relative advantage gained by the adoption of the innovation. As service organization, the physician must consider the economic performance of the practice, ergo the economic compensation related to the product. As appointment management is just a supporting function, and not directly related to the actual

physical well-being of the patient, any innovation in that regard will most likely not qualify as a benefit covered by the insurance companies. In this case, the clinic itself takes on the role as *The Payer*. Therefore, the opinion of the patient only plays a minor role.

Finally, Effort Expectancy and Data Security were both found to be non-significant influencing factors. With regard to the results of the principal component analysis and the therein identified factor loadings, the insignificance of EE must be attributed to measurement error first. The insignificance of DS can be cautiously seen as a positive sign for the introduction of software systems, as it indicates that the current state of technology is trusted, and no negative prejudices exist.

In conclusion, this work cannot provide an all-encompassing analysis of the determinants of the adaptation of new technologies for the management of medical appointments. In part, this is attributable to the small sample and time and resource constraints of the study, but also to the complexity and multifaceted nature of the problem. Nevertheless, to a certain extent, all research question could be answered, and an initial and substantial understanding of the issue could be generated. This offers valuable suggestions for software providers and many possibilities for future research.

6.1. Managerial Implications

Based on these conclusions, some suggestions are proposed to the developers or distributors of relevant software systems. First, the adoption of technologies by physicians is rather rational and comparably insensitive to influence of patients or competition. Therefore, when promoting the technology product, the focus needs to be on the potential economic gains that can be achieved through its usage. Frankly, physicians need to be convinced that the service is not just for the convenience of the patient. This requires a comprehensive business plan that clearly demonstrates when the initial investments will break-even, how costs will be saved and/or revenues can be increased through the usage of the technology (e.g., through reduced required staffing for patient care). Otherwise, the cost-benefit ratio will not satisfy them.

Second, practice staff needs to be considered for promotion as well as product development. Research results has proven that they have a relatively high influence on the technology adaption decision in this context. As they are the people operating the technology they are to be considered as indirect decision makers.

Third and following on from the previous point, both employees and patients should be engaged as social agents. Even if the patients' opinion was proved to be comparably low, it still was significant. Furthermore, results indicated that physicians were somewhat not aware of the extent of dissatisfaction of patients regarding waiting time. The cumulative conviction of patients and employees regarding adoption of the system can be used as leverage to put pressure on decision makers to act. This may include the submission of explicit opinion polls to provide convincing evidence for the physician as well as marketing campaigns aimed directly at these two groups to increase awareness and desire.

Fourth, ease of use and integration into existing practice processes must be taken into account during development as well as subsequent marketing. Although the influence of EE could not be credibly measured in this study, complexity and compatibility are still important factors to consider regarding the diffusion of innovation, especially in context of hectic practice processes and existing management systems. To promote adoption, developers need to design and develop suitable interfaces and formats that can be adapted to different practice structures and requirements. Also relating to the diffusion factor for "Trialability", the offer for test runs of the system might be a useful tool for this purpose. Lastly, the final offering needs to be an adequately augmented product. This includes appropriate training for employees as well as reliable and comprehensive customer service and support.

6.2. Limitations

The findings of this study are subject to several limitations. Firstly, due to the small number of respondents, resulting from limited access to primary care physicians, the study is not sufficient to provide a true probability sample. The resulting consequences are inconclusive results with low statistical power, limited generalization of findings, and insufficient internal validity of the study. As a result

of convenience sampling, the participant group consisted predominantly of physicians from only two different types of medical specialties, which is not an adequate representative of outpatient practitioners in Germany. Due to the ratio of 2:1 for female and male participants, the results also must be considered as somewhat gender biased. Furthermore, the study was limited by considerable time constraints, affecting the scope of the study, possible level of detail and potential research methods. The underlying conceptual framework, focused solely on PE, EE, SI and DS as influencing factors of the behavioral intention of physicians. Any kind of moderators (i.e., age, gender etc.) were not taken into consideration for the analysis. The 21.4% of unexplained variance, identified within MLR analysis, indicate further factors that were not considered in the model. For Likert-scale items, a balanced scale was chosen to avoid biased results due to forced responses. However, this introduced the central tendency error which had a tremendous impact on research results and greatly impeded the establishment of meaningful conclusions. In addition, questions and answers within the survey were fixed (closed response). Individual perceptions and experiences of the respondents that could have provided interesting insights were thus disregarded (Bryman, 2012). An example of this is the question Q10, which asks for the reasons of any delays occurring within the appointment- schedule. The answer options were determined on the basis of preceding in-depths interviews. However, it cannot be ruled out that respondents had additional reasons that were not included. Furthermore, due the use of an online survey it cannot be assessed whether each individual participant has fully concentrated on the questions throughout the survey and resulting inconsistencies in the data may have caused poor results. Especially in connection with the considerable length of the survey questionnaire, this must be taken into account. Due to the absence of the interviewer or moderator within online surveys, the results also might be affected by eventual misunderstanding of certain questions that would have needed further explanation. This is especially true for the scenario description and subsequent concept-related questions. The way the scenario-based survey was designed and conducted also carried several limitations. Participants had to formulate expectations regarding a fictional app to answer the questions and could not draw on actual experience, which may have led to inadequate answers. Additionally, the study was based on only one single scenario and did not include any kind of “control scenario” to monitor effects of variation. It must be considered

that the choice of a different scenario or even small deviations and details in the corresponding description may have led to completely different perceptions/responses of the participants. The explanatory text only included images of the application's user interface from the customer's perspective. However, for a more accurate assessment, images of the user interface from the physician's perspective could have been added. The transformation of the measurement items of the respective constructs from previous studies, was based on face validity, which entails a high degree of subjectivity and is considered as rather "weak" form of validity. Also, each of the constructs of social influence (PI, CI, EI) was only measured through two items. Although certain literature qualifies this as acceptable minimum, various sources recommend at least three items per variable for comprehensible evaluation/information. According to factor loadings, also the construction of the measurement instrument for EE, was insufficient. Finally, although anonymity was guaranteed, a reporting bias due to social desirability and self-expectation may still exist. An example would be a lower rating of the expected performance increase from the use of the technology, to downplay the advantages and necessity of innovation/ new technologies and not put themselves under pressure to act.

6.3. Suggestions for Future Research

The conducted research provides a first insight into the influencing factors of physician's attitude towards the adaption of new technical solutions for appointment management. However, also regarding the before mentioned limitations, there are various aspects that allow for further investigation. In order to strengthen the exploration of the relationship between the data and obtain a more complete and reliable analysis of results, future research should be conducted on a significantly expanded scope of investigation. This includes the acquisition of a larger and more representative study sample and redefinition of measurement scales for different constructs. In addition, other influencing factors that were not considered in this study should be verified. A more detailed analysis of the correlations between the individual predictors offers additional potential for insightful findings as the multicollinearity analysis indicated strong relationships between some of the constructs. Further research may also investigate the effect of potential moderators/mediators on the causal relationships in the model, such as

age, gender, medical specialty etc. For example, other studies found that older adults are slower to adopt new technologies than younger adults (Czaja et al., 2006), this could be a first point of reference. As a next step, the research questions may be transferred to other countries in order to explore the effect of cultural differences and varying healthcare infrastructure. Finally, besides including a variation of scenarios the prototypical development of a corresponding system should be considered to enable respondents to assess construct items on actual experience by means of test runs. This could also address the intention-behavior gap, which was excluded from this study.

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Appendix

Appendix 1: Questionnaire and Survey Flow

Survey Flow

Introduction (1 Item)
Block 1: General Questions (14 Questions)
Block 2: Waiting Time
Keep up (1 Item)
Block 3: Scenario Testing (7 Questions)
Validation (1 Item)
Block 4: Demographic Questions End (4 Questions)

Start of Block: Introduction

Hello!

This survey is made in context to my master thesis for my International MSc. in Business at the BI Norwegian Business School.

Participation in this study is voluntary and there is no right or wrong answer, I am merely interested in your honest opinion. Every answer will be anonymous and will only be used for the purpose of my study. No personal information of yours (E-Mail, IP-Address etc.) will be gathered.

You will first receive a few questions regarding the type and scope of the practice you are working in and your appointment scheduling process. Afterwards, you will be presented with a scenario regarding a potential new technology. Please take your time to read this carefully before answering the questions that will follow.

The survey will take about 10 -15 min.

If you are interested in the results of this study, you can contact me by email and I will provide them to you free of charge. You will find the corresponding mail address at the end of the questionnaire.
I highly appreciate your time to answer my survey.
Thank you!

End of Introduction

Start of Block 1: General Questions

Q1 What is the medical specialty of your practice/the practice you work at?

- [ ] General Medicine (1)
- [ ] Internal Medicine (2)
- [ ] Orthopedics (3)
- [ ] Gynecology (4)
- [ ] Dentistry (5)
- [ ] Other (6)

Q2 How many patients are treated in your practice per day approximately? (overall)
- Use slider to insert your answer-

0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150

No. of treated patients approx. ()	

Q3 How many patients do you treat yourself per day approximately?

0 10 20 30 40 50 60 70 80 90 100

No. of treated patients approx. ()	

Q4 How can appointments be made at your practice?
(Choose all that apply)

- [ ] Telephone (1)
- [ ] Fax (2)
- [ ] E-Mail (3)
- [ ] Online Booking service (4)
- [ ] In person/ at practice directly (5)

Q5 What is the average age of the patients you treat at your practice ?

0 10 20 30 40 50 60 70 80 90 100

Average age of patients ()	

Q6 How much time do you schedule per patient?

0 10 20 30 40 50 60 70 80 90 100

Scheduled time per patient in minutes ()	

Q7 Do you schedule time buffers ? (e.g. scheduling "extra" time that would not be necessary if the day went exactly according to plan)

- ○ Yes (1)
- ○ No (2)

Display This Question:

If Q7 = Yes

Q8 How much time buffer per person do you schedule?

	0 5 10 15 20 25 30
Scheduled buffer time per patient in minutes ()	

End of Block 1: General Questions

Start of Block 2: Waiting Time

Q9 Can you always keep to your daily schedule exactly?

- Always (22)
- Most of the time (23)
- About half the time (24)
- Sometimes (25)
- Never (26)

Display This Question:

If Q9 = Always

Or Q9 = Most of the time

Or Q9 = About half the time

Or Q9 = Sometimes

Q10

What are the reasons that your schedule cannot be met exactly?

	Never (16)	Rarely (17)	Sometimes (18)	Often (19)	Always (20)
The treatment of a patient takes longer than anticipated (1)	○	○	○	○	○
Needed to squeeze in an emergency patient (2)	○	○	○	○	○
Inefficiencies in the general operating process/ practice management (3)	○	○	○	○	○
Patients being late for their appointment (4)	○	○	○	○	○

Q11 What is the average wait time of your patients (From the time of their scheduled appointment to the time they are actually being examined)?

	0 10 20 30 40 50 60 70 80 90 100
Approx. average waiting time of one patient in minutes ()	

Q12 Please state your opinion to each of the following statements regarding the effect of patient waiting time on your practice. (Patient waiting time = the time they have to wait within your practice, until being examined)

	Strongly disagree (1)	Somewhat disagree (2)	Neither agree nor disagree (3)	Somewhat agree (4)	Strongly agree (5)
Patient waiting time doesn't really effect my practice at all (1)	○	○	○	○	○
Patient waiting time is unavoidable (2)	○	○	○	○	○
I have to invest extra resources due to waiting time (e.g. longer working hours, extra personell) (3)	○	○	○	○	○
Patient waiting time causes economic drawbacks for my practice (4)	○	○	○	○	○

Q13 Please state your opinion to each of the following statements regarding the effect of patient waiting time on your patients. (Patient waiting time = the time they have to wait within your practice, until being examined)

	Strongly disagree (1)	Somewhat disagree (2)	Neither agree nor disagree (3)	Somewhat agree (4)	Strongly agree (5)
My patients don't mind the waiting time within my practice (1)	○	○	○	○	○
When I politely explain the reasons to my patients why they had to wait, they understand (2)	○	○	○	○	○
My patients perceive the time they have to wait as unpleasant (3)	○	○	○	○	○
My patients enjoy the time they have to wait within my practice (4)	○	○	○	○	○
My patients perceive the time they have to wait as ineffective (5)	○	○	○	○	○

Q14 Have you taken any action to address the issue of patient waiting time/ issues related to it?

- ○ Yes, I have (1)
- ○ So far, I have not been able to find any useful measures (2)
- ○ It was not possible (e.g missing resources, no time, not integrable etc.) (3)
- ○ No, it wasn't necessary (4)

End of Block 2: Waiting Time

Start of Keep up

You are halfway through the survey already! Keep going! 😊

End of Keep up

Start of Block 3: Scenario Testing

Q15 **Please read the following scenario very carefully.**

Imagine a technology that manages the appearance of your patients in a "just in time" manner. Instead of having to wait in your waiting room, the patients will be able to spend their time outside and only enter the practice when they can go directly into the examination room to be treated. To wait in the waiting room, remains an option of course.

Your patients will have an application on their phone that gives them access to an accurate real-time wait estimation until they are being examined (similar to food delivery applications like foodora, lieferando etc.). From a certain time before the appointment, they must be in close proximity to your practice. When you are ready to examine the patient, he/she will receive a notification, that he/she can enter your practice and go directly into the examination room. When something is holding you up (treatment of patient takes longer than anticipated, unexpected incident..), the timer on the application will be updated immediately for the patient. The system will be interlinked with your patient data management system and your appointment schedule management system. This makes it possible for the patient to "check-in" before the appointment (i.e. health insurance card) via the application as well.

Example:
"Bob" is an existing patient at you practice.
He has an appointment at 11 am. 2 hours before, Bob checks the app and sees that everything seems to go as planned.
A little later, Bob sets off to your practice to be there on time for the appointment. While he is on his way, he receives a notification via the app on his phone, informing him that it will take a few minutes longer until he will be examined. Bob decides he then has enough time, to stop at the super market on the way and get the few missing groceries for tonights dinner. Afterwards, Bob continues driving to your practice, and parks the car close by.
He receives a notification that the doctor is ready to see him in 5 minutes. Bob gets out of his car and starts walking up to your practice. Finally, he receives a notification that you are ready to receive him in Examination room 2 . He enters the practice subsequently and goes directly to room 2.

What you/other practice employees would have to do:
The system will be connected with the already established general appointment scheduling system of your practice. In order to make the service work, you would have to feed the system with the relevant information, meaning, live updates on your current schedule fulfillment. When you start treating a patient, you (or your medical assistent) would have to insert this in the interface of the system on your computer. When you can anticipate that you will need longer to treat your patient, you will have to enter this into the system with an approximate minute indication. When you finished the treatment of the patient, and are ready for the next one, you will have to insert that (you or your medical assistant).

Please answer the following question in regard to this scenario. Please let your opinions not be influenced by minor details of the example/service (You don't have a supermarket close by, or examination rooms don't have numbers etc.) but try to answer the questions in regard to the general idea.

Q16 Performance

	Strongly disagree (1)	Somewhat disagree (2)	Neither agree nor disagree (3)	Somewhat agree (4)	Strongly agree (5)
This service will improve my work performance (1)	○	○	○	○	○
This service will increase my productivity (2)	○	○	○	○	○
This service will enhance my effectiveness in my work (3)	○	○	○	○	○
This service will be useful for my work (4)	○	○	○	○	○
This service will increase the quality of care I provide to my patients (5)	○	○	○	○	○

Q17 Necessary Effort

	Strongly disagree (1)	Somewhat disagree (2)	Neither agree nor disagree (3)	Somewhat agree (4)	Strongly agree (5)
My interaction with the system is clear and understandable (1)	○	○	○	○	○
Interaction with the system will not require a lot of mental effort (2)	○	○	○	○	○
The system will be easy to use (3)	○	○	○	○	○
This service can be easily integrated in the practice processes (4)	○	○	○	○	○
I can easily provide the resources needed for the use of this service (5)	○	○	○	○	○
The resources needed for the implementation of this service are minor (6)	○	○	○	○	○
I can easily convince my employees/ co-workers to use this service (7)	○	○	○	○	○

Q18 Opinion of others

	Strongly disagree (1)	Somewhat disagree (2)	Neither agree nor disagree (3)	Somewhat agree (4)	Strongly agree (5)
Other practices, of the same medical specialty as mine, would be interested in this service (1)	○	○	○	○	○
My patients would like this service (2)	○	○	○	○	○
My employees/ co-workers would like this service (3)	○	○	○	○	○
Other practices might implement a service like this soon (4)	○	○	○	○	○
My employees/ co-workers would want this service to be used at my practice (5)	○	○	○	○	○
My patients would want this service to be used at my practice (6)	○	○	○	○	○
My patients would switch to another practice if they would offer this service (7)	○	○	○	○	○

Q19 Security of patient data

I believe that it is technically possible to design the app in such a way that..

	Strongly disagree (1)	Somewhat disagree (2)	Neither agree nor disagree (3)	Somewhat agree (4)	Strongly agree (5)
... the personal information of my patients is safe (1)	○	○	○	○	○
.. unauthorized people will not be able to gain access to my patients' personal information (2)	○	○	○	○	○
... unauthorized access will be detected immediately (e.g., cyberattack) (3)	○	○	○	○	○

Q20 Intention

Assuming that such a system now exists..

	Strongly disagree (1)	Somewhat disagree (2)	Neither agree nor disagree (3)	Somewhat agree (4)	Strongly agree (5)
I would like to implement a system like this (1)	○	○	○	○	○
I will definitley implement a system like this in the future (2)	○	○	○	○	○
I will consider implementing a system like this (3)	○	○	○	○	○

Q21 Before today, have you already thought about the implementation of a solution like this/similar to this ?

○ Yes (1)

○ No (2)

End of Block 3: Scenario Testing

Start of Validation

QC Please indicate your agreement with the following statements regarding the scenario given to you

	Strongly disagree (8)	Somewhat disagree (9)	Neither agree nor disagree (10)	Somewhat agree (11)	Strongly agree (12)
The scenario was realistic (1)	○	○	○	○	○
The scenario was easily understandable (2)	○	○	○	○	○
It was easy answering the questions in regard to the scenario (3)	○	○	○	○	○

End of Validation

Start of Block 4: Demographic Questions End

Q22 Where are you/ your practice located?

- ○ Germany (1)
- ○ Norway (2)
- ○ Other European country (3)
- ○ USA (4)
- ○ Other (5)

Q23 What is your gender?

- Male (1)
- Female (2)
- Non-binary / third gender (3)
- Prefer not to say (4)

Q24 What is your age?

0 10 20 30 40 50 60 70 80 90 100

Age ()

Q25 What is your profession?

- Doctor (1)
- Medical Assistant (2)
- Other (3)

End of Block: Demographic Questions End

Appendix 2: Frequencies waiting time items

Item	Never N (%)	Sometimes N (%)	About half of the time N (%)	Often N (%)	Always N (%)
Q9 Can you always keep to					
Q10 Reasons why					
Treatment takes longer					
Emergency patient					
Inefficiency in practice process	6 (12%)	8 (16%)	24 (48%)	11 (22%)	1 (2%)
Patient being late	8 (16%)	28 (56%)	5 (10%)	7 (14%)	2 (4%)
Item	**Strongly disagree N (%)**	**Somewhat disagree N (%)**	**Neither agree nor disagree N (%)**	**Somewhat agree N (%)**	**Strongly agree N (%)**
Q12 Influence of patient waiting time on practice					
Doesn't affect at all	4 (8%)	4 (8%)	16 (32%)	21 (42%)	5 (10%)
Is unavoidable	3 (6%)	7 (14%)	13 (26%)	23 (46%)	4 (8%)
Invest extra resources	4 (8%)	8 (16%)	24 (48%)	11 (22%)	3 (6%)
Economic drawback	5 (10%)	23 (46%)	18 (36%)	3 (6%)	1 (2%)
Q13 Influence of patient waiting time on patient					
Patients don't mind	2 (4%)	6 (12%)	30 (60%)	9 (18%)	3 (6%)
I if explain they understand	2 (4%)	9 (18%)	27 (54%)	11 (22%)	1 (2%)
Perceive it as unpleasant	10 (20%)	27 (54%)	12 (24%)	0	1 (2%)
They enjoy it	2 (4%)	6 (12%)	30 (60%)	9 (18%)	3 (6%)
Perceive it as ineffective	2 (4%)	9 (18%)	27 (54%)	11 (22%)	1 (2%)

Appendix 3: Item-Total Statistics

Performance Expectancy

Cronbach's Alpha	Cronbach's Alpha Based on standardized items	N of Items
.897	.902	5

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
PE 1	10.00	9.592	.836	.777	**.854**
PE 2	9.96	9.917	.819	.766	**.860**
PE 3	10.08	10.116	.762	.738	**.871**
PE 4	9.56	9.517	.750	.687	**.873**
PE 5	10.08	9.912	.698	.516	**.891**

Effort Expectancy

Cronbach's Alpha	Cronbach's Alpha Based on standardized items	N of Items
.903	.905	7

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
EE 1	16.60	22.776	.668	.547	**.894**
EE 2	16.62	22.118	.765	.832	**.883**
EE 3	16.96	22.100	.690	.778	**.892**
EE 4	17.56	22.782	.698	.516	**.891**
EE 5	17.22	22.542	.683	.722	**.893**
EE 6	17.38	22.200	.812	.789	**.878**
EE 7	17.54	24.131	.696	.535	**.892**

Patients' Influence

Cronbach's Alpha	Cronbach's Alpha Based on standardized items	N of Items
.726	.724	3

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
PI 1	5.10	1.765	.613	.618	**.555**
PI 2	5.20	1.633	.751	.656	**.375**
PI 3	6.10	2.418	.324	.160	**.878**

Competitors' Influence

Cronbach's Alpha	Cronbach's Alpha Based on standardized items	N of Items
.751	.753	2

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
EI 1	3.02	.469	.603	.364	-
EI 2	2.98	.551	.603	.364	-

Employees' Influence

Cronbach's Alpha	Cronbach's Alpha Based on standardized items	N of Items
.924	.925	2

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
EI 1	2.58	.698	.860	.739	-
EI 2	2.54	.743	.860	.739	-

Data Security

Cronbach's Alpha	Cronbach's Alpha Based on standardized items	N of Items
.924	.926	3

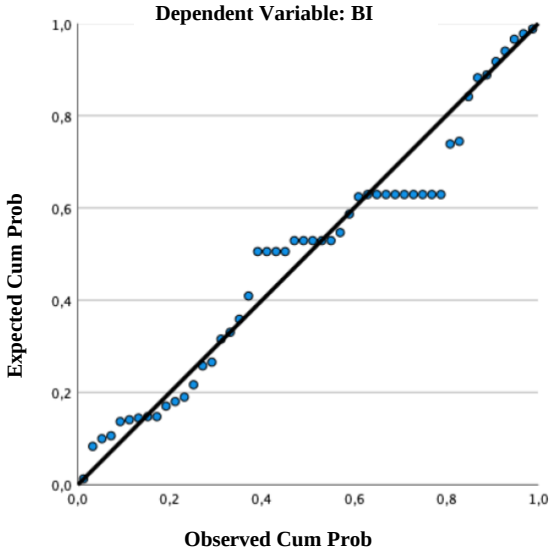
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
DS 1	5.66	2.923	.821	.675	**.916**
DS 2	6.12	3.128	.871	.767	**.870**
DS 3	6.26	3.298	.854	.744	**.886**

Behavioral Intention

Cronbach's Alpha	Cronbach's Alpha Based on standardized items	N of Items
.901	.900	3

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
BI 1	5.26	3.176	.835	.702	**.830**
BI 2	5.42	3.187	.811	.672	**.851**
BI 3	4.92	3.463	.765	.587	**.890**

Appendix 4: Normal P-P Plot of Regression Standardized Residual



Appendix 5: Scatterplot of residuals