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Navigating Human Behavior for the Successful Digital Transformation of the Healthcare Sector

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"We are human beings,
not human doings."

– Origin unknown

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Eileen Doctor, August 2024

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[1] Available at https://www.dfg.de/resource/blob/289676/89c03e7a7a8a024093602995974832f9/230921-statement-executive-committee-ki-ai-data.pdf (Accessed: 31.07.2024)

Abstract

Healthcare is at a turning point. Fully embracing digital transformation could lead to substantial improvements in efficiency, accuracy, and patient-centered care. Reaching the target state of digital transformation – *digital maturity* – involves the comprehensive integration and sustained utilization of information systems (ISs) across all operations, which improves efficiency, effectiveness, grants better working conditions for medical professionals, and overall better patient experiences. However, the path to digital maturity is fraught with challenges that extend beyond mere technology adoption, encompassing the navigation of regulatory, organizational, cultural, and individual factors that are deeply influenced by medical values. While technology often receives priority, digital transformation's success fundamentally depends on human and organizational factors, particularly the role of medical professionals, whose effectiveness is directly linked to the support they receive from ISs.

It is crucial to address the human element if one is to ensure that ISs are not only implemented but also fully embraced and effectively utilized to meet the needs of both practitioners and patients. Incorporating contextual factors into the analysis of human-IS interactions ensures that solutions are relevant, user-centric, and aligned with organizational objectives. Similarly, understanding individual factors – such as personal characteristics, technological proficiency, and attitudes towards IS – is critical for facilitating digital transformation, particularly when beliefs and behaviors may conflict with such initiatives' goals. Given the very high failure rates associated with digital transformation initiatives, it is imperative to effectively manage the human factor. As transformational tools, maturity models offer a structured framework for assessing organizational readiness, guiding improvements, and aligning digital strategies with healthcare professionals' needs. By adopting a holistic, human-centered approach, with the help of maturity models, healthcare organizations can more effectively integrate the contextual and individual factors, thereby increasing the likelihood of successful digital transformation, enhancing both patient care and operational efficiency.

This cumulative dissertation delves into the complexities of digital transformation in healthcare organizations, emphasizing the dynamic interplays between contextual and individual factors that influence healthcare professionals' interactions with ISs. Further, it identifies operational mechanisms to facilitate digital transformation, employing maturity models as strategic tools to achieve targeted outcomes. This dissertation comprises six essays, four of which focus on the contextual and individual determinants that shape the interactions between healthcare

professionals and ISs. These determinants include environmental conditions, organizational elements, and social norms, as well as role-specific individual factors such as limited resources and time, minimum requirements for the adoption of ISs, professional ethos, digital knowledge and literacy levels, and IT-related anxiety. The other two essays explore the development processes, dimensions, and mechanisms of maturity models, considering the medical sector's specific requirements, the potentials for these models to foster consensus and secure federal funding, and the varying capacities for action and directive authority across organizations.

The implications of this cumulative dissertation extend to policymakers, system vendors, healthcare associations, healthcare organizations, and medical professionals. These stakeholders are called on to contribute by reflectively considering human behaviors, thereby supporting the step-wise digital transformation and the advancement towards digital maturity in healthcare organizations.

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List of Abbreviations

AI	Artificial Intelligence
COVID-19	Coronavirus Disease 2019
DOI	Diffusion of Innovation Theory
DRG	Diagnosis Related Group
e-health	Electronic Health
EHR	Electronic Health System
EMRAM	Electronic Medical Record Adoption Model
GDPR	EU's General Data Protection Regulation
HIS	Hospital Information System
IS	Information System
IT	Information Technology
MM	Maturity Model
MotM	Motivational Model
PHA	Public Health Agency
PHAMM	Public Health Agency Maturity Model
RG	Research Goal
RHPN	Regional Hospice and Palliative Care Network
SCT	Social Cognitive Theory
TAM	Technology Acceptance Model
TPB	Theory of Planned Behavior
TRA	Theory of Reasoned Action
U.S.	United States of America
UTAUT	Unified Theory of Acceptance and Use of Technology

1 Motivation

Juxtaposed with tradition and innovation, the healthcare sector is at a decisive juncture, where the promises of digital transformation offer a new era of efficiency, accuracy, and patient-centered care (Kraus et al. 2021). This transformative process is aimed at enhancing medical quality, streamlining workflows, and reducing costs, thereby fundamentally changing operations to maximize the value for patients (Williams et al. 2019). The promise of digital transformation in healthcare extends beyond mere modernization – it envisions a future in which care is more accessible, personalized, and proactive, ultimately improving health outcomes (Kraus et al. 2021; Teixeira et al. 2022). When the vision of digital transformation is fully achieved across all operations, this can be described as *digital maturity*, involving holistically integrated, effectively utilized and sustained information systems (ISs) to their full potentials (Woods et al. 2023a).

Outside of simply upgrading IS resources, digital transformation is a multifaceted and intricate process, fundamentally reimagining how services are delivered and experienced – in the sphere of healthcare, for both medical professionals and patients (Carroll 2020; Carroll et al. 2023; Cresswell et al. 2019). Digital transformation extends over adopting new technologies and ISs to the regulatory, organizational, cultural, and individual contexts, highly influenced by medical and role-specific values (Duncan et al. 2022). While technology is often seen as the main driver of digital transformation and digital maturity, the human and organizational factors are considered more critical (Carroll et al. 2023; Kane 2019; Wessel et al. 2021). Common misconceptions about strategies, inadequate engagement with stakeholders, and insufficient project management have led to staggering failure rates of 65% to 90% across industries, highlighting the need for a deeper understanding of the underlying failure causes in healthcare as well (Granja et al. 2018).

Navigating digital transformation requires a holistic perspective that considers and balances humans (considering their abilities, limitations, needs, and behaviors), tasks (including their objectives, processes, workflows, and complexity), and technologies (used to accomplish these tasks, covering hardware, software, user interfaces, and the overall technological environment). In this regard, the use of ISs in healthcare holds unique requirements compared to other industries owing to the critical nature of medical work, patient-provider relationships, and the need for interdisciplinary collaboration between providers and institutions (Harbishettar et al. 2019; Morley and Cashell 2017). With varied technological proficiency among medical

professionals and the imperative to integrate seamlessly into clinical workflows while maintaining high levels of security and privacy, the integration and management of ISs in healthcare is challenging yet crucial for improving patient interaction, patient care and operational efficiency (Pfob et al. 2021). Medical professionals' abilities to perform effectively and efficiently are directly influenced by the support they receive from ISs, which should not only integrate with but also optimize existing workflows, making processes more efficient and reducing the immense administrative burden that healthcare providers are confronted with daily (Flanagan et al. 2013).

Accordingly, a crucial part of digital transformation is to grasp and address the human element, the emotions, needs, values, and experiences of end users of ISs, and to translate them into requirements. This focus ensures that technological advancements are not just implemented, but are wholeheartedly embraced and effectively utilized according to the needs of practitioners and patients (Duncan et al. 2022; Felmingham et al. 2021). Thus, medical professionals' behaviors regarding ISs are central to the success of digital transformation in healthcare (Woods et al. 2023a). The research has shown that factors such as facilitating conditions, perceived usefulness, ease of use, social influences, and individual beliefs strongly impact on the adoption of new technologies and, when associated with low effort and high benefits, ISs are likely to gain a foothold (Bandura 1986; Davis 1985; Venkatesh et al. 2003). In this regard, the attitude, acceptance, adoption, and effective use of digital technologies by healthcare professionals are critical to realizing the benefits of these innovations on an organizational layer (Buck et al. 2022; Cresswell et al. 2013; Diel et al. 2023; Flanagan et al. 2013). Supported by these behavioral insights and with holistic respect to the complexities of digital transformation, this cumulative dissertation delves into healthcare organizations, *focusing on the dynamic interplays between the contextual and the individual factors that shape healthcare professionals' interactions with ISs*. By focusing on these factors and introducing healthcare-specific operational mechanisms, I have sought to gather real-world insights to improve digital transformation and reach digital maturity, enhance operational efficiency, and ultimately provide better patient care.

Supporting the transformational process, the development and application of maturity models (MMs) play a crucial role, offering a structured framework for assessing the current state, identifying areas for improvement, and systematically planning progressive enhancements (Becker et al. 2009; Bruin et al. 2005). Beyond this strategic perspective, MMs serve as

powerful communication and vision tools, helping to align stakeholders around a shared understanding of the goals and steps necessary for digital transformation (Doctor et al. 2023). Leveraging these foundational characteristics, this dissertation further serves as a detailed guide to *understanding the various elements and mechanisms necessary for healthcare organizations reaching a digital transformation target state, with a focus on the behavioral component*. It takes the standpoint that a concerted effort from all stakeholders is needed, at the governmental, self-governing, system design, organizational, and end-user levels. Each has a crucial role in navigating human behaviors in the digital transformation process. By working together, these stakeholders can navigate the challenges and harness the full potentials of digital technologies to enhance digital maturity in healthcare organizations.

Structured into eight sections, this cumulative dissertation systematically explores and addresses the complexities of digital transformation in healthcare organizations. The sections build on one another to provide a comprehensive understanding of the topic, from conceptual baselines to practical implications. Section 2 lays the foundation by introducing core concepts of digital transformation and digital maturity, explaining how readiness and maturity are assessed and achieved. It also examines high failure rates of digital transformation projects, identifying common pitfalls and challenges. Emphasizing the human factor, it details research into beliefs and behaviors that influence the use of health information technologies and concludes with the strategic use of MMs. Section 3 outlines my research aims and goals, providing a detailed overview over the specific research objectives addressed in the subsequent essays. Section 4 describes the research methods, offering a methodological framework for the studies and analyses. Section 5 presents the main findings as summaries of the included essays, divided into two sections: the first explores factors affecting the use of ISs (on the examples of artificial intelligence (AI), telemedicine, and hospital ISs) by healthcare professionals, while the second focuses on the development and application of MMs in public health agencies and regional networks. Section 6 provides an aggregated discussion of the results, highlighting their contributions to both theory and practice. Section 7 addresses the research's limitations and suggests areas for future study to further advance the field. Section 8 concludes the dissertation by summarizing key insights and reiterating the importance of the findings for improving digital maturity, operational efficiency, and patient care in healthcare organizations.

2 Conceptual Background

2.1 Digital Transformation of Healthcare Organizations

Digital transformation refers to the extensive integration of digital technologies across all areas of an organization, fundamentally altering its operations and its ways of delivering value to its customers or stakeholders (Vial 2019). Generally, this improves customer experiences, creates new business models, and generates competitive advantages in a rapidly changing market (Mishra et al. 2023). While digital transformation is a key concept in the IS research, we lack a standardized definition owing to its dependence on context. It is deeply rooted in technology, innovation, culture, organizational, and strategy research, and it is often confused with related terms such as *digitization* and *digital disruption* (Wessel et al. 2021). The concept of digital transformation can be traced back to 1958, when information technology (IT) was discussed as a tool for process optimization and managerial decision support (Leavitt 1958). Digital transformation seeks to enhance an organization by instilling significant changes through the integration of information, computing, communication, and connectivity technologies (Vial 2019). Thus, it encompasses more than merely integrating technologies; it fundamentally alters the ways in which (healthcare) staff deliver medical, administrative, and supporting deliverables and ultimately value to customers – here, patients (Kruszyńska-Fischbach et al. 2021). Digital transformation involves comprehensive changes in organizational strategy, operations, and the work environment, creating new value propositions (Bobera and Stojanović). This process leads to the emergence of a new organizational identity, distinguishing it from traditional IT-enabled transformations that support existing value propositions (Vial 2019; Wessel et al. 2021). Digital transformation is pivotal in the progression of digital change, moving from IT-supported, to digitally transforming, and eventually to fully digital organizations (Carroll et al. 2023). Herein, effective change management and strategic agility are crucial for success (Guinan et al., 2019).

The primary motivation for adopting digital technologies in healthcare is enhanced medical service quality plus cost reduction. This approach fundamentally changes organizations' operations, with the ultimate goal of improving the value delivered to patients (Kraus et al. 2021). These advancements lever (emerging) technologies to improve medical quality and increase patient satisfaction, while streamlining overall operations and enhancing healthcare delivery's overall effectiveness and efficiency (Williams et al. 2019). Evidence shows improved access to patient data, smooth workflows, and better decision-making, for instance

with e-health records, digital imaging, (AI-based) decision support, and other digital tools (Fagerlund et al. 2019; Hackett et al. 2019; Haggerty 2017; Piliouras et al. 2015). To avoid the trap of implementing technology for its own sake, it is crucial to define what digital transformation does and does not mean for an organization (David and Jahnke 2004; Hofmann 2002). Recent studies warn that implementing technologies in healthcare without a clear strategy can lead to significant risks, including privacy breaches, ethical issues, and the exacerbation of health disparities (Kalra and Seitzinger 2022; Khatiwada et al. 2023; Murdoch 2021; Sunarti et al. 2021). Rigorous evaluation and strategic planning are essential to ensure that a technology serves its intended purpose and benefits patient care. Every organization's approach to digital transformation will vary based on its starting point, competitive niche, and desired outcomes (Carroll et al. 2023). While the speed of digital transformation is often used as an indicator of progress, true success involves deeper business, structural, and cultural changes (Carroll et al. 2023). Compared to various advanced service providers or industry players – for instance in digital business models or manufacturing – who capitalize on emerging technologies to stay ahead of their competitors, healthcare organizations proceed at a slower pace and aim for a technology-driven efficiency booster to survive under increased demand and limited resources (Gopal et al. 2019; Mncedisi Willie and Nkomo 2019). Digital transformation is never the sole purpose, as the focus is on the capabilities and potential advancements behind the transformation (Williams et al. 2019). Vial (2019) reminded us that technology is just one part of the complex puzzle that organizations need to solve if they are to remain competitive. A digital transformation initiative's success relies on the ability to understand and navigate project complexities, supported by a coherent vision and effective implementation. In the following, digital transformation is viewed as an organizational change process, not just an outcome (Matt et al. 2015) and according to Alami (2016), digital transformation is doomed to fail without preparation – so-called readiness. Its importance cannot be overstated, as readiness ensures that all stakeholders are prepared, engaged, and aligned with the transformation goals.

2.2 Strategic Advantages with Digital Maturity

Healthcare organizations must ready themselves to successfully implement and sustain digital transformation initiatives and reach their target goal (Kruszyńska-Fischbach et al. 2021; Lassnig et al. 2022; Pirola et al. 2020). Technical capabilities describe one's ability to implement, integrate, and utilize technological resources for enhanced organizational performance. This includes the capacity to effectively use digital tools to fulfil one's role, and it extends to communication with other participants in the health system, the social system, as

well as with patients and relatives (Krasuska et al. 2020). Organizational capabilities are the ability to execute operational processes and procedures, including aspects such as culture, workforce, and strategy. This involves for instance a willingness to adopt new perspectives and foster a culture that aligns with a healthcare organization's strategic goals, promoting change and innovation (Benitez et al. 2018; Krasuska et al. 2020; Wu et al. 2010). Recent studies have emphasized that high digital readiness allows healthcare organizations to streamline their operations, reduce costs, and improve resource management through advanced data analytics and automation (Bilgiç and Camgöz Akdağ 2023) as well as to experiment with emerging technologies such as AI, machine learning, and blockchain, in the sense of curiosity and continual innovation (Gardner et al. 2023).

Following this preparatory stage of building the capabilities to undertake the digital transformational process, digital maturity describes the extent to which an organization has successfully integrated and optimized digital technologies within its operations, specifically how healthcare organizations use these technologies to improve their service quality (Teixeira et al. 2022). It measures how well digital tools and processes are embedded in clinical and administrative functions, enhancing efficiency, patient care, data management, and overall service delivery. It also reflects the levels of sophistication and optimization of digital processes and technologies as well as the capability to interact across organizations (Duncan et al. 2022; Phiri et al. 2023). When an organization achieves high digital maturity, this indicates enhanced capabilities, i.e., it has effectively integrated digital practices into its core operations and is compatible with external stakeholders, leading to increased efficiency, effectiveness, and scalability (Duncan et al. 2022; Phiri et al. 2023; Rapaccini et al. 2013). The fundamental idea behind maturity is that digitally mature organizations operate systematically, while immature ones rely on the extraordinary efforts of individuals who use ad hoc methods to achieve their goals (Liu et al. 2011). Following Salviotti et al. (2019), achieving digital maturity provides a strategic advantage by positioning organizations as leaders in their field, for instance, higher digital maturity levels relate to significantly better patient experience outcomes, as evidenced in U.S. hospitals with data from the well-known electronic medical record assessment model (EMRAM) and patient feedback regarding hospital experiences (Snowdon et al. 2024). These organizations can better handle challenges that arise from dynamic healthcare demands, for instance, high medical needs in the Coronavirus Disease (COVID-19) pandemic (Doctor et al. 2023), and foster a culture that is attractive to overstrained medical staff and beneficial in terms of collaborating with others (Teixeira et al. 2022).

There are multiple reported dimensions of digital maturity; they describe technological and organizational peak capabilities as well as the mediating environmental support. Commonly reported dimensions are of technological, organizational, and human-centered perspectives; taken together, these dimensions enhance the ability to effectively use digital technologies (Duncan et al. 2022). However, it is important to recognize that maturity dimensions are highly context-dependent and vary significantly based on individual and organizational prerequisites, goals, and external environments, which is why, in this dissertation, I have aggregated a high-level baseline of commonly reported dimensions in healthcare settings. Following Liaw and Godinho (2023) in their comprehensive assessment of digital health and capability MMs, essential foundations are the infrastructure, crucial digital tools, the readiness to share information, enablers of trust and adoption, as well as quality improvement, monitoring, and evaluation. Infrastructure and essential digital tools are vital, and exemplary dimensions encompass for instance IT capability, as the adoption and use of comprehensive IT infrastructure, systems, and technologies that are both functional and efficient (Carvalho et al. 2019b; Duncan et al. 2022; Martin et al. 2020). This is accompanied by the readiness to share information in terms of interoperability, which ensures that data and information can be seamlessly exchanged within the organization and across different care settings that involve patients, caregivers, and families (Duncan et al. 2022; Krasuska et al. 2020). Enablers of trust and adoption are among the most prominent foundations and exemplary dimensions encompass for instance leadership in the creation and implementation of a strategic plan to meet organizational goals and objectives, aligning with digital transformation efforts (Carvalho et al. 2019a; Duncan et al. 2022). Further, governance highlights an organization's dedication to policy development, integrated workflows, risk management, and capacity-building, as well as the adherence to government policy on data, design, infrastructure, governance, and standards (Duncan et al. 2022; Potter et al. 2018). To account for the human element, I add people, skills, and behaviors to the clustered foundations of Liaw and Godinho (2023) so as to emphasize the stakeholders (providers and patients) as enablers of trust and adoption and their digital literacy and motivation to effectively lever technology (Duncan et al. 2022; Flott et al. 2016; Krasuska et al. 2020; Teixeira et al. 2022). In healthcare settings, patient-centered care promotes the active participation of patients, caregivers, and families in health decisions, providing them with access to health data and enabling the co-creation of service delivery (Duncan et al. 2022; Grooten et al. 2018).

In summary, the digital transformation of healthcare is the overarching process of integrating digital technology to revolutionize operations. Digital readiness is about preparing a healthcare organization to undertake this transformation, ensuring that it has the necessary capabilities and mindset. Digital maturity represents the advanced stage where digital transformation is fully embedded, optimized, and continually driving value in the organization and for the stakeholders. Together, these concepts are crucial for healthcare organizations that seek to advance into a digital era and thrive, providing a roadmap from initial transformation planning to fully realized digital maturity.

2.3 Failures of Digital Transformation in the Healthcare Sector

The path of digital transformation towards digital maturity is fraught with challenges that can derail even the most well-planned initiatives. As organizations strive to reach this advanced stage, they must navigate various complexities (Oludapo et al. 2024). Reaching digital maturity is a critical strategic aim for many organizations, and the belief that the path of digital transformation delivers ultimate value persists, envisioned as a key to future success despite its inherent complexity and the daunting evidence against achieving it (Carroll et al. 2023; Phiri et al. 2023). Understanding the reasons for these failures is crucial for developing strategies that mitigate risks and increase the likelihood of success. This brings us to the critical examination of digital transformation failures and the factors that contribute to these outcomes. Organizations imagine the digital transformation process to be an ultimately successful one, even though the odds are stacked against success (Carroll et al. 2023). The literature reveals that large-scale technological change initiatives often face significant challenges, leading to historically low success rates, with failure rates commonly around 70% but reaching up to 90% (Davenport and Westerman 2018; Munns et al. 2022; Oludapo et al. 2024; Ramesh and Delen 2021; Schneider and Kokshagina 2021; Volberda et al. 2021; Wade and Shan 2020). The high failure rates of digital transformation projects have substantial financial implications. The academic literature estimates that, globally, failed digital transformations result in losses of $1.3 trillion per year (Ramesh and Delen 2021). This trend is evident across industries, geographies, and organizational sizes, where the drive for digital transformation is strong but often pursued without adequate understanding or consideration of the associated risks, barriers, and challenges (Brosnan et al. 2023). IT projects in general can expose organizations to significant risks, including unpredictable and extreme cost overruns (Flyvbjerg et al. 2022).

There are many reasons for digital transformation failure; these are individual to healthcare organizations, which face significant digital transformation challenges that are specific to their sector. The healthcare sector is heavily **regulated**, and frequent changes in policies and regulations create an environment of uncertainty, which can impact on technology choices, data management practices, and protection of patient privacy (Gifford et al. 2024). Compliance requirements can add complexity and cost to digital initiatives, often necessitating additional investments in compliance technologies and expertise. These large, complex entities are pressured to deliver more with fewer resources, making effective digital strategies harder to execute and more prone to failure (Bunduchi et al. 2020). Funding for digital transformation initiatives competes with other critical needs, such as patient care, staffing, and medical supplies, which can result in underfunded projects that fail to achieve their objectives (Kotenko and Bohnhardt 2021). Inertia, where existing resources and capabilities hinder disruption, is a significant barrier. This inertia is deeply rooted in both tangible elements, such as medical equipment and facilities, and intangible ones, such as capabilities, which suppress digital technologies' innovative power (Vial 2019).

Digital transformation failures often stem from **strategic misalignments** and flawed assumptions in organizations (Volberda et al. 2021). A misaligned value proposition – where an organization struggles to maintain consistent value delivery as demands and technological advancements such as AI evolve – makes it hard to ensure that digital initiatives continually meet the intended expectations (Carroll et al. 2023). According to a systematic review of digital transformation in healthcare, a key identified challenge was the misalignment between digital initiatives and broader business objectives, which is a primary responsibility of executive leaders and senior managers (Kraus et al. 2021). Darmawan and Laksono (2021) emphasized that effective leadership is crucial for the successful adoption and integration of digital technologies, and that misalignment between leadership vision and operational execution often results in digital transformation projects not receiving the prioritization or funding necessary for long-term success (Kane et al. 2015; Mishra et al. 2023). Also, digital transformation initiatives often become overcomplicated with unnecessary technological additions driven by executive sponsors or project team members that do not necessarily address specific problems (Mielli and Bulanda 2019; Sanchez et al. 2017). The perceived obvious value of digital transformation can also lead to initiation without clearly defining every aim and assessing associated risks, further contributing to high failure rates (Brosnan et al. 2023). In many healthcare settings, decisions are made by a small group of senior leaders without sufficient

inputs from frontline staff and reflection on the tasks that need to be performed with digital support. This top-down approach can lead to a lack of buy-in from those directly affected by the changes (Roman et al. 2017). Organizations also mistakenly view digital transformation as a purely top-down effort, neglecting the importance of combining top-down management with bottom-up approaches to sustain the transformation process over time (Carroll et al. 2023). Further, the assumption that outsourcing technology provision is sufficient often shackles organizations to providers who may not adapt to shifting business needs without prohibitive costs, distancing an organization from owning and integrating technologies as a core competency (Heracleous and Gledhill 2024). A critical assumption is that substantial investment in digital transformation will naturally ensure that objectives trickle down to the operational level (Kane et al. 2015; Westerman and Bonnet 2015). However, without a coherent strategy that integrates digital initiatives into the big picture, these projects often lack the necessary support and alignment (Volberda et al. 2021). Also, the expectation of undergoing transformational processes with little guidance explains the high failure rates commonly associated with digital transformation projects (Carroll et al. 2021; Wade and Shan 2020). In this regard, technology should be viewed as a tool to enhance people and processes, rather than as a solution to organizational issues (Carroll et al. 2023; Mielli and Bulanda 2019). The lack of a coherent strategy as well as the top managers not playing a key role often lead to failure (Westerman and Bonnet 2015), for instance, healthcare organizations that lack a unified digital transformation strategy may implement fragmented solutions that do not communicate well with one another, leading to inefficiencies and data silos (Ajer et al. 2019).

Besides top-level management, digital transformation failures in healthcare often stem from **operational leadership and management issues**. The responsibility for leadership and management issues usually lies with mid-level and operational managers who are tasked with executing the digital transformation initiative. These department heads, project managers, and other leaders often lack transformational skills, sticking to hierarchical styles, which fail to lever social capital or incentivize digital transformation (Brenk et al. 2019). Risk-averse leaders adopt digital transformation superficially without full support owing to a lack of pressure to change, potentially rushing into large-scale projects without understanding their potential benefits and risks, and lacking the digital knowledge and transformational attributes needed for success (Hu 2018). Some prioritize grand projects for funding, leading to investments in vague concepts rather than necessary infrastructure (Sanchez et al. 2017). A major issue is the disconnect between clinical leaders and IT ones. Isolated digital transformation efforts relieve other parts

of an organization from engaging in the change process, hindering success (Heracleous and Gledhill 2024). For instance, the implementation of electronic health (e-health) records without sufficient inputs from clinicians can lead to systems that are cumbersome to use and are poorly integrated into clinical workflows, reducing their effectiveness and acceptance (Cresswell et al. 2013). Without shared objectives, traditional habits prevail and integration efforts fail, with natural tendencies of retreating into specialized domains, undermining ambidextrous leadership development (Heracleous and Gledhill 2024; Tushman et al. 2011). This is particularly detrimental in healthcare, where interdisciplinary collaboration is essential for holistic patient care.

This is accompanied by **poor project and stakeholder management**. Despite being a long-standing part of IS implementation, project management is often cited as a major cause of project failures (Alami 2016). The research highlights that many large healthcare IT projects fail owing to inadequate project management practices, with a significant percentage of these failures attributed to poor planning and execution (Dendere et al. 2021). Smaller projects tend to have a lower risk of failure than larger ones, and failures often occur because projects cannot thrive in unbalanced ecosystems. A project's ecosystem must be kept balanced, with disturbances detected and managed accordingly (Boonstra and Vries 2015). Transformations require flexible roadmaps rather than rigid schedules and must account for the magnitude of change to tailor an effective delivery strategy (Vial 2019). Many projects fail owing to a simplistic view of execution, lacking the know-how and proper planning necessary for success. The pressure to adhere to an unrealistic original vision can introduce fragility into a project ecosystem, leading to failure (Alami 2016). Inadequate stakeholder management is another critical factor, as funders and stakeholders who are not closely involved in a project are more likely to be responsible for its failure. It is therefore crucial to engage a wide variety of end-users and key stakeholders (Alami 2016). A lack of transparency, poor communication, uncertainty about direction, and unrealistic expectations further lead to the normalization of issues that contribute to digital transformation efforts' failure (Carroll et al. 2023). Complex task requirements in healthcare – such as content, multiple data sources and types, security, and interoperability standards – necessitate significant upfront time investment for thorough analysis which, although initially time-consuming, ultimately reduces the complexity and risks (Alami 2016; Dendere et al. 2021). When needs cannot be identified and documented, requirement analysis suffers, leading to flawed implementation (Brosnan et al. 2023).

Many organizations fail owing to **issues in culture** because they focus on technological changes without building a holistic plan and overlooking the necessity for major cultural, strategic, and procedural changes (Carroll et al. 2021; Carroll et al. 2023; Vial 2019; Volberda et al. 2021). Thus, organizations must foster a digital mindset and the agility to respond to technological disruptions (Vial 2019) – a culture where sharing and contributing to digital initiatives is rewarded and recognized (Morgan et al. 2021). The deeply ingrained culture of healthcare, which prioritizes established clinical practices and face-to-face interactions, can clash with the adoption of digital tools (Cresswell et al. 2019). For instance, a culture that values thoroughness and caution over speed and efficiency may be less receptive to rapid technological changes. Medical professionals may also feel that their clinical judgment is being undermined by automated systems, leading to resistance (Greenhalgh et al. 2018). Further, a lack of awareness about current sector trends and public sector organizations' vulnerability to *lomanism*, where enthusiasm for vendor products overshadows critical assessment, further hinders digital transformation efforts, highlighting the need for greater digital literacy (Goldfinch 2007; Mu and Wang 2022). According to Sullivan and Staib (2018), there is also an unintentional tendency to perceive new technologies as causes of errors or failures, regardless of causality (so-called *digital hypervigilance*), as the transformation process heightens awareness and sensitivity.

Regarding **technological** solutions, vendors often prioritize sales over ensuring that their solutions meet organizations' legitimate needs (Mielli and Bulanda 2019), which, to worsen matters, rely on these vendors for ongoing support after implementation. Poor post-implementation support can leave organizations struggling to manage and optimize new technologies, reducing their effectiveness and lifespan (Oludapo et al. 2024). Insufficient testing can result in deploying technological solutions plagued with bugs and glitches; also, without thorough quality assurance, new healthcare technologies may not perform as expected in real-world conditions, disrupting business operations and causing user dissatisfaction, leading to performance issues that hinder productivity and require costly reworking (Corrao et al. 2010). Many healthcare organizations rely on outdated electronic health record (EHR) systems and other legacy technologies that are incompatible with modern solutions, causing the maintenance to be resource-intensive, both financially and regarding human resources, diverting essential resources from digital transformation initiatives and time spent with patients (Akinola and Telukdarie 2023; Mielli and Bulanda 2019; Penrod 2017). Outdated legacy systems impede connectivity between new and existing systems, exacerbating failure risks

(Kempeneer and Heylen 2023). Modern digital healthcare solutions – such as telemedicine and cloud-based EHR systems – demand a robust network infrastructure. Insufficient hardware infrastructure and connectivity (e.g., bandwidth) can lead to bottlenecks, cause slow performance, user frustration, and decreased productivity (La Torre-Díez et al. 2015). On the other hand, new technologies can expose organizations to new security risks. Without proper security measures, these vulnerabilities can be exploited by cyberattackers, leading to data breaches and causing financial losses, reputational damage, and losses of provider and patient trust (Hathaliya and Tanwar 2020). Siloed operations and non-interoperable IT systems hinder data integration and analytics, further raising the likelihood of failure. In this infrastructure, new technologies may not seamlessly integrate, leading to added interoperability issues that cause operational disruptions and necessitate additional investments in custom integration solutions (Granja et al. 2018). Herein, success seems to be harder to achieve as the technology's complexity or the scope of its implementation increases (van Gemert-Pijnen et al. 2011).

From an organizational perspective, **human factors** are often the biggest barrier to successful digital transformation in healthcare. The weight of academic opinion highlights that significant transformation of the workforce is integral to digital success (Carroll 2020; Kane 2019; Wessel et al. 2021; Woods et al. 2023a). Digital transformation introduces new technologies and processes that many healthcare professionals may be unfamiliar with. This can lead to anxiety and reluctance to adopt new systems due to fear of making mistakes or job insecurity (Buck et al. 2022). Further, healthcare professionals are often overburdened with patient care responsibilities, leaving little time for learning and adapting to new digital tools (Flanagan et al. 2013). A common issue is imbalanced workforce composition; as organizations bring in new, digitally adept employees to implement digital processes, conflicts often arise with experienced staff who are accustomed to existing workflows. This *social paradox* can significantly disrupt the transformation process. Practitioners may be reluctant to embrace new tools and systems, preferring to stick with familiar methods. This resistance can stall or completely derail digital transformation efforts (Wimelius et al. 2021). *Digital churn* describes increased turnover after digital disruptions owing to either a lack of ability or willingness to work with a new technology, sometimes also due to strong emotional reactions to change, similar to change fatigue and post-digital depression (Sullivan and Staib 2018). Thus, overcoming these human barriers requires careful management of workforce changes and addressing the underlying causes of resistance to ensure a smoother transition to digitalized operations. For instance, Tyrov et al. (2022) describe how change management principles help

overcome resistance among medical personnel when implementing a platform for online appointments, electronic records, and prescriptions. Similarly, Kraus et al. (2021) emphasized that it is crucial to address the cultural and behavioral aspects in the digital transformation of healthcare, as they directly impact on staff members' willingness to engage with new technologies.

In summary, the high failure rates of digital transformation projects underscore the need for a deeper understanding of the underlying causes. Various factors – such as misaligned strategies, inadequate stakeholder engagement, and insufficient project management – contribute to these failures. Among these, human factors play a pivotal role. From resistance to new technologies to conflicts arising from workforce changes, leadership, and project implementation, the human element often has the strongest impact on successful digital transformation. While technology is often seen as the driver of digital transformation, human and organizational factors are usually more critical in effective digital transformation. Employees play a crucial role in either enabling or hindering digital transformation, making it essential to cultivate a culture that is agile, risk-tolerant, and experimental. Understanding the importance of the implementation and the evaluation perspectives of technologies is vital for sustaining the digital transformation process; this requires a comprehensive approach that includes managing workforce changes, fostering a culture of acceptance, and putting people at the center of digital initiatives. By focusing on these aspects, organizations can more effectively manage the challenges of digital transformation, avoid potential failures, and increase their likelihood of long-term success. I argue that understanding the relationships between medical personnel and ISs is essential to the counteracting of digital transformation failures and the driving of sustainable change in healthcare settings.

2.4 Synthesizing Factors of Belief and Behavior regarding Health Information Technology Use

2.4.1 Established Determinants of Belief and Behavior

The high failure rates of digital transformation initiatives in healthcare underscore the need for a deeper understanding of the underlying causes. With the human factor in focus, it is essential to dive into medical personnel's behavioral determinants that affect technology acceptance and utilization, so as to create a supportive environment. To achieve this objective, one must translate theoretical components into practice-relevant categories.

A review of the established behavioral models in the context of technology acceptance and utilization reveals that, despite their various terminologies and conceptual frameworks, these models consistently focus on a core set of factors. The main theories of behavior research converge on key determinants such as perceived usefulness, ease of use, social influences, and individual beliefs. This convergence underscores the importance of these fundamental factors in shaping behavioral components regarding IS, particularly in healthcare settings. By synthesizing these common elements, I seek to develop comprehensive insights to support the digital transformation and maturity of healthcare organizations. This approach offers several significant advantages. First, I categorize theoretical components into thematic clusters to provide a clear, structured overview over the influencing factors. From this, I can identify relevant variables and their interrelationships, as well as the most pertinent factors that are crucial for my research. Translating these theoretical concepts into practice-relevant categories aids in applying them to concrete cases in healthcare. This enables the direct application of research findings in practice, which facilitates the development of tailored solutions that address the specific needs of the healthcare sector. For instance, training programs aimed at increasing self-efficacy can be more effectively designed when relevant components are clearly identified (Buck et al. 2022). I will now group and discuss the key determinants of the most established theoretical models in the technology acceptance research in Table 1 and detail these clusters with exemplary studies from the healthcare domain. I include the following theories and models in their core publication scope: the Technology Acceptance Model (TAM) (Davis 1985), the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al. 2016), Diffusion of Innovation Theory (DOI) (Rogers 2003), the Theory of Reasoned Action (TRA) (Fishbein and Ajzen 1975), the Theory of Planned Behavior (TPB) (Ajzen 1991), Social Cognitive Theory (SCT) (Bandura 1986), and the Motivational Model (MotM) (Davis et al. 1992). Further, I integrate the *benefit intention* concept (Soffer et al. 2023).

Table 1: Clusters of Established Determinants of Belief and Behavior

Cluster	**Component**	**Theoretical source**
Perception of usefulness and utility (*perceived benefits and utility of ISs*)	Perceived usefulness	TAM
	Performance expectancy	UTAUT
	Relative advantage	DOI
Usability and complexity (*ease or difficulty of using IS*)	Perceived ease of use	TAM
	Effort expectancy	UTAUT
	Complexity	DOI
Social influences and norms (*impacts of social environments*)	Subjective norms	TRA, TPB
	Social influences	UTAUT
Control beliefs and resources (*perceived control and support*)	Perceived behavioral control	TPB
	Facilitating conditions	UTAUT
	Self-efficacy	SCT
Expectations and motivations (*motivation and expected outcomes*)	Outcome expectations	SCT
	Intrinsic motivation	MotM
	Extrinsic motivation	MotM
	Benefit intention	Soffer et al. (2023)
Compatibility and visibility (*fit and visibility of IS benefits*)	Compatibility	DOI
	Trialability	DOI
	Observability	DOI
Behavioral intentions and uses (*intentions and de facto uses of IS*)	Behavioral intention	TRA, TPB, TAM
	Behavioral intention to use	UTAUT

2.4.2 Detailing of Clusters and Health-Related Importance

Understanding how medical personnel **perceive the usefulness and utility** of ISs is crucial for fostering acceptance and usage (Davis 1985; Rogers 2003; Venkatesh et al. 2003). This cluster includes the components *perceived usefulness* (TAM), which refers to the belief that using a technology will enhance job performance or overall effectiveness. Similarly, *performance expectancy* (UTAUT) describes the extent to which an individual believes that using a technology will help attain gains in job performance. *Relative advantage* (DOI) is the degree to which an innovation is perceived as better than the existing solution. These components collectively highlight this cluster's importance in the acceptance and effective use of ISs. In the

– time-pressured – medical service provision, this cluster's importance is highlighted, for instance by Nie et al. (2023), who proposed a web-based electronic communication and collaboration platform designed to facilitate team-based care for hospitalized patients with complex needs. This study underscores the critical role of perceived usefulness in technology adoption, emphasizing that systems should be intuitive to users, for instance, in this use case, requiring minimal documentation or training. When perceived as beneficial, they are more likely to be used effectively and to allow for the shared communication and collaboration experience of interprofessional teams. Buck et al. (2022) emphasized positive expectations that using AI in medical diagnosis can enhance diagnostic quality and efficiency, especially for rare diseases where GPs may have less experience. This can support decision-making and provide legal backing, leading to increased acceptance and integration of AI technology in medical practice. Ashtari and Bellamy (2019) identified perceived advantages such as improved efficiency and error reduction as crucial for nurses' acceptance of electronic medical records, emphasizing the practical benefits that healthcare professionals seek from new technologies.

Addressing barriers and challenges associated with **usability and complexity** is essential for promoting IS adoption (Davis 1985; Rogers 2003; Venkatesh et al. 2003). This cluster includes *perceived ease of use* (TAM), as the extent to which a person believes that using a technology will be free from effort. Similarly, *effort expectancy* (UTAUT) is the perceived effort associated with using a technology. Further, *complexity* (DOI) describes how difficult an innovation is to understand and use. These components underscore the significance of user-friendliness and simplicity in technology acceptance. For instance, perceived ease of use positively affects user satisfaction and the intention to use hospital information systems (HISs), with aspects such as timely information, efficiency, and transparency exerting strong influences on medical users' perceptions (Agunga et al. 2021). Lower effort expectancy correlates with higher acceptance and usage rates for mobile health applications among diabetic patients, highlighting simplicity's role in driving technology adoption (Petersen et al. 2020). Studies on complexity across various healthcare innovations revealed that dynamic, unpredictable, and interrelated components can lead to difficulties in technology adoption and sustainability. When systems are perceived as overly complex, they struggle to achieve mainstream adoption and deliver their intended outcomes (Greenhalgh et al. 2018).

It is crucial to consider the impacts of **social influences and norms** if one is to understand technology adoption (Ajzen 1991; Fishbein and Ajzen 1975; Venkatesh et al. 2003). This cluster includes *subjective norms* (TRA, TPB), as the perceived social pressure to (not) perform

a particular behavior. *Social influence* (UTAUT) also fits here, describing the extent to which an individual perceives that important others to them (e.g., role models, directives, or colleagues) believe that they should use the new technology. These components highlight social context's role in shaping technology acceptance. Subjective norms have been shown to positively affect clinicians' behavioral intention to adopt (AI-) driven smart healthcare services for image analysis, surgical navigation, and diagnosis (Pan et al. 2019). Colleagues' expectations and behaviors can create normative pressure that influences individual healthcare professionals to adopt new technologies. Therein, the influence of colleagues and institutional expectations can significantly encourage clinicians to embrace new technologies, indicating that peer approval and expectations are critical for technology adoption (Pan et al. 2019). Likewise, Gopalakrishna-Remani et al. (2019) highlighted that normative pressures in institutions, along with absorptive capacity and top management participation, indirectly influence the EHR adoption level. As institutional policies and regulations create a standard of behavior that employees are expected to follow, these can establish a culture that either supports or hinders technology adoption (Okediran et al. 2020). When managers actively participate in the adoption process, it creates a positive environment that encourages technology use, which suggests that social norms in an organization play a role in technology uptake (Gopalakrishna-Remani et al. 2019).

Focusing on the perceived support and ability to use ISs, the cluster **control beliefs and resources** is crucial for facilitating adoption (Ajzen 1991; Bandura 1986; Venkatesh et al. 2003). This cluster includes *perceived behavioral control* (TPB), which relates to the perceived ease or difficulty of performing a behavior. *Facilitating conditions* (UTAUT) describes the extent to which an individual believes that, e.g., organizational and technical infrastructure exist to support a technology's use. *Self-efficacy* is also included, representing the belief in one's capabilities to successfully execute the required actions. These components emphasize the importance of control beliefs and resource availability in technology usage. When healthcare professionals feel they lack control over system functionalities, they are more likely to not accept the technological solution, engaging instead in workaround behaviors to meet their needs (Buck et al. 2020). Further, validated instruments developed to measure the self-efficacy of healthcare workers, particularly older nurses, have shown that higher self-efficacy is linked to better perceived usability and effectiveness of for instance HISs (Weathersby-Holman 2021). Along with perceived usefulness and perceived ease of use, perceived behavioral control strongly influences healthcare professionals' intentions to adopt (AI-driven) healthcare services

such as diagnostics and intelligent image analysis. This highlights the importance of perceived control in motivating behavior change (Pan et al. 2019).

Identifying **expectations and motivations** that influence usage is essential for understanding technology acceptance (Bandura 1986; Davis et al. 1992). This cluster includes *outcome expectations* (SCT), as the expected outcomes of performing a specific goal-directed behavior. *Intrinsic motivation* (MotM) describes the drive to perform an activity for its inherent satisfaction, while *extrinsic motivation* (MotM) refers to the drive to perform an activity to achieve external rewards or avoid punishment. The recent healthcare literature highlights that outcome expectancy, as the anticipated results of telehealth implementation, is significantly shaped by physicians' prior experiences and self-efficacy, impacting on their overall expectations and acceptance of telehealth in primary healthcare (Qashqary 2024).
Also, researchers emphasize that intrinsic motivation, driven by enjoyment and self-efficacy, significantly enhances the adoption and continued use of telehealth technologies among healthcare professionals. Extrinsic motivation, influenced by external rewards and organizational support, drives initial adoption but may not sustain long-term engagement without intrinsic satisfaction, which is crucial for developing effective telehealth implementation strategies (Shahbaz and Zahid 2022). In this context, overall value provision is the ultimate goal. Thus, the motivation is aimed at direct or indirect benefits (Soffer et al. 2023), for instance for the IS user, the patients, the local unit, or the healthcare organization. These components highlight motivation's role in shaping technology adoption and usage.

Considering **compatibility and visibility**, how well ISs integrate into existing workflows and how visible their benefits are is important for promoting adoption (Rogers 2003). This cluster includes *compatibility* (DOI), which describes how well an innovation fits existing values, past experiences, and the needs of potential adopters. *Trialability* (DOI) refers to the extent to which an innovation can be tested prior to full adoption, while *observability* (DOI) is the extent to which an innovation's results are visible to others. These components underscore the significance of compatibility and visibility in technology acceptance. For instance, regarding mobile health tools, Jacob et al. (2020) argued for the importance of compatibility with current healthcare practices and systems. Technologies that align with healthcare professionals' existing workflows and values are more likely to be adopted. Such integration reduces disruption and resistance among users, similar to healthcare providers' assessment of a technology's usability and effectiveness through testing, which reduces perceived risks and increases confidence in the technology's potential benefits. Conducting pilot projects and trials

help assess a new system's practical benefits and usability, fostering a more informed decision-making process (Hayes et al. 2015). When healthcare professionals can see a technology's positive impacts, such as improved patient outcomes or increased efficiency, they are more likely to support and adopt it. Technologies that demonstrate clear and observable improvements in workflow efficiency or patient outcomes are more likely to be adopted (Lin and Bautista 2017).

Measuring the de facto readiness and behaviors towards using ISs, **behavioral intention and use** is crucial for understanding technology adoption (Ajzen 1991; Davis 1985; Fishbein and Ajzen 1975; Venkatesh et al. 2003). This cluster includes *behavioral intention* (TRA, TPB, TAM), which refers to the intention to perform a specific behavior. *Behavioral intention to use* (UTAUT) also fits here, describing the intention to use a technology. Behavioral intention refers to the immediate precursor of a behavior, specifically the motivation or intention to perform a certain behavior in the near future. Behavioral intention is important because it often leads to de facto behaviors and can be used to predict and modify human actions (Fishbein and Ajzen 1975). This dissertation follows the research insights into how the aforementioned key factors – perceived usefulness, performance expectancy, relative advantage, perceived ease of use, effort expectancy, complexity, subjective norms, social influence, perceived behavioral control, facilitating conditions, and motivations – and the individual's currently active goals all culminate in shaping behavioral intention. This hierarchical level underscores these factors' collective impact, positioning behavioral intention as the key determinant in de facto adoption and use of technology. Highlighting behavioral intention as a distinct hierarchical level underscores its pivotal role in translating the aforementioned factors into de facto technology adoption and its ultimate de facto uses (Fishbein and Ajzen 1975). De facto usage behavior is a critical measure of technology adoption's success. It indicates whether a technology's intended benefits are being realized and how effectively it is being integrated into everyday practices. High levels of de facto usage behavior reflect successful adoption of healthcare technologies and can lead to improved performance outcomes, increased efficiency, and better patient care (Pan et al. 2019; Saigi-Rubió et al. 2016; Sánchez-Prieto et al. 2017). Hence, in the following, behavioral intention is an intermediary between influencing factors and de facto behaviors, with a focus on the factors that shape this intention.

In summary, it is crucial to align behavioral determinants to practical implementation strategies so as to seamlessly integrate technology into healthcare environments. This ensures that

technology adoption goes beyond merely meeting theoretical expectations; it must also resonate deeply with healthcare professionals' real-world beliefs, needs, and day-to-day experiences. By doing so, the adoption process becomes more intuitive and meaningful for those on the front line of care, fostering acceptance as well as sustained and effective use of new technologies. This approach recognizes that successful digital transformation in healthcare requires a nuanced understanding of human factors, where technology is adapted to fit healthcare providers' unique workflows and challenges, ultimately leading to better patient outcomes and more efficient healthcare delivery.

2.5 The Maturity Model as the Tool of Choice for Successful Digital Transformation

To effectively manage the human factor and its various influences, especially in light of the high failure rates in digital transformations, the use of an appropriate tool is essential to achieving gradual and considered success. It is important that the participants' behaviors form an integral part of the model to ensure that technological advancements are not only implemented but also effectively utilized and accepted. Building on the foundational knowledge of the key roles of human beliefs and behaviors in healthcare professionals' adoption and utilization of digital tools, I will now explore MMs' role as a strategic tool to guide and evaluate the digital transformation process, incorporating technological, organizational, and human elements. By assessing an organization's digital maturity, these models help identify strengths, weaknesses, and areas for improvement, ensuring that human factors are integrated into the digital transformation journey for a more holistic and sustainable implementation.

Several digitalization frameworks exist to help organizations to transform. Assessing digital maturity with a structured instrument enables organizations to determine their readiness to integrate digital technologies and, ultimately, to derive roadmaps with the aim of improving patient care (Johnston 2017). MMs are widely established frameworks that support the evaluation of organizations concerning their existing competencies and capabilities, structured along sophistication levels. In principle, these models aim to characterize the typical practices used by an organization or organizational unit in its domain at distinct levels of evolution (Becker et al. 2009; Bruin et al. 2005). Thus, they offer opportunities to establish what may be considered good and bad practices (Fraser et al. 2002). The initial level equals limited capabilities, with some organizations or organizational units potentially not even reaching the

lowest state, while the highest level represents the vision: maturity in their domain (Adekunle et al. 2022). These levels are outlined for thematic, context-specific, and highly individual dimensions to define core capabilities of an organization, such as the introduced technological and organizational characteristics, the human stakeholders involved, and their associated goals (Bruin et al. 2005). Sequentially working through these aforementioned levels outlines an ideal development path with step-wise milestones, which allows continuous progress and reflection on priorities and decisions and, in a continuous model, allows for the mix-and-match selection of fitting target routes, see Figure 1 (Bruin et al. 2005). Thus, MMs lay the foundation for the derivation of strategies that target specific areas, also cross-dimensionally (Becker et al. 2009; Paulk et al. 1993), again broadening the possibilities for increasing capabilities (Lasrado et al. 2015). MMs help identify shared goals that align to both the strategic vision and staff members' day-to-day realities, creating a unified direction and jointly stated vision. The involvement of frontline staff in the initial assessment phase is vital, as it helps capture practical insights and experiences, creating a realistic view of current capabilities and areas that need improvement, as well as a sense of identification with the goals (Doctor et al. 2023). From a motivational perspective, continually tracking progress and celebrating milestones helps maintain momentum and keeps everyone informed about advances, reinforcing a shared vision and shared understanding (Doctor et al. 2023). Further, MMs' structuredness promotes transparency in the evaluation process, building trust and encouraging active participation in interim reworking and adjustments (Doctor et al. 2024).

Figure 1: Continuous Maturity Model Scheme (following Lasrado et al. 2015)

		Maturity stages				
		1	2	3	4	5
Capability area 1	Practice 1.1	X	X	X	X	
	Practice 1.2	X	X	X	X	X
	…					
Capability area 2	Practice 2.1	X	X			
	Practice 2.2					
	…					
…	…					
	…					
	…					
Capability area n	Practice n.1	X				
	Practice n.2	X	X			
	…					

The application scenarios for MMs – a recognized tool in the IS research that has proven successful in organizational self-assessment and roadmap planning – are broad. Application areas include business process management (Bruin et al. 2005) with its historical reference, the Capability Maturity Model Integration (Carnegie Mellon, Software Engineering Institute 2024), IT management (Becker et al. 2009), knowledge management (Freeze and Kulkarni 2005), or e-government (Gottschalk 2009), to name a few. As in other domains, MMs' potentials are recognized in health-related research, with both the literature and practice applying MMs to specific care scenarios (e.g., telemedicine) (Otto et al. 2019), infection surveillance (Tom-Aba et al. 2020), or regional care networks (Doctor et al. 2023). MMs on emerging technologies in healthcare include big data (Daraghmeh and Brown 2021), blockchain implementation (Akbar et al. 2022), Industry of Things in hospitals (Hasić et al. 2022), and ISs/HISs or parts thereof (Carvalho et al. 2016, 2019b; van de Wetering and Batenburg 2009). They are also defined to advance particular technological capability areas, such as e-health interoperability (Guédria et al. 2012), information security (Akinsanya et al. 2020), or IT infrastructure (Gomes and Romão 2018). It is hard to choose the most fitting MM for digital transformation initiatives in healthcare, as existing models are highly context-specific and strongly focused on technology-related assessments (Carvalho et al. 2019a; Duncan et al. 2022), making them the subject of critical discussions regarding overall, holistic feasibility and balanced outcomes (Woods et al. 2023a), for instance, the EMRAM (HIMSS 2024), which lacks insights into necessary information and communication infrastructure to transition from paper-based to digital processes (Williams et al. 2019). The organizational capabilities and the human element in this medical service domain are evident in MMs, for instance as *people* dimensions, subdimensions, and/or practices that concretize the human element in employee awareness, training, team constellation, and/or culture (Carvalho et al. 2019c). However, from the organizational perspective of holistic transformation and given the importance of human behavior, these models are not necessarily highlighted or detailed, and they lack the stringency needed to reflect human behaviors across all dimensions. Thus, I argue that, to lever manifold potentials, MMs need to adequately incorporate contextual and individual factors that shape the interactions between healthcare professionals and ISs in a holistic way.

According to Woods et al. (2023a), to date, the application of MMs in healthcare has primarily been about reflecting on and driving the digital agenda, recognizing maturity gaps, and prioritizing areas for change based on an understanding of current conditions. Second, stakeholders recognize the need for self-assessment to provide transparent insights into

strengths, weaknesses, and opportunities as a basis for benchmarking and as supporting data for financial decisions, governance, and strategic planning.

In the public health context of health organizations, for instance hospitals with their dualistic financing, applying an MM can inform investment decisions or can be the rationale for grant applications (HIMSS 2024). Ultimately, healthcare providers can use these tools ongoingly as a way to monitor the development of the digital transformation process, thereby also coordinating activities, motivating involved personnel with step-by-step updates on capability advances, efficiency increases, and patient-related outcomes (Cresswell et al. 2019; Kolukısa Tarhan et al. 2020). Woods et al. (2023a) point out that most healthcare stakeholders strongly agreed on MM applications at various healthcare system layers, particularly at the federal, state, and regional levels. They also agreed that overall responsibility for MMs in the healthcare sector should rest with governments, while the assessment of digital maturity should be done by the healthcare organizations themselves.

In summary, MMs are an indispensable tool for achieving purposeful digital transformation in healthcare. Their structured framework for assessment, roadmap for improvement, integration of top-down priorities, shared vision with bottom-up approaches, and facilitation of effective communication and collaboration make them ideally suited to address the complexities and challenges of digital transformation. Ideally, the outcomes of MM applications include an actionable blueprint of what an organization can implement in the short, medium, and long term so as to improve digital maturity (Woods et al. 2023a). By focusing on human participation in digital transformation, healthcare organizations can navigate their journey with clarity, purpose, and confidence, ultimately leading to improved patient care and operational efficiency.

3 Research Agenda

3.1 Research Aim

The overall research aim of this doctoral dissertation is to investigate the multifaceted factors that influence the interactions between ISs and healthcare professionals in their role as medical providers and to contribute to the successful digital transformation of healthcare organizations by incorporating considerations regarding healthcare professionals' behaviors in transformation instruments – specifically, MMs. This overarching aim led me to three primary research goals (RGs):

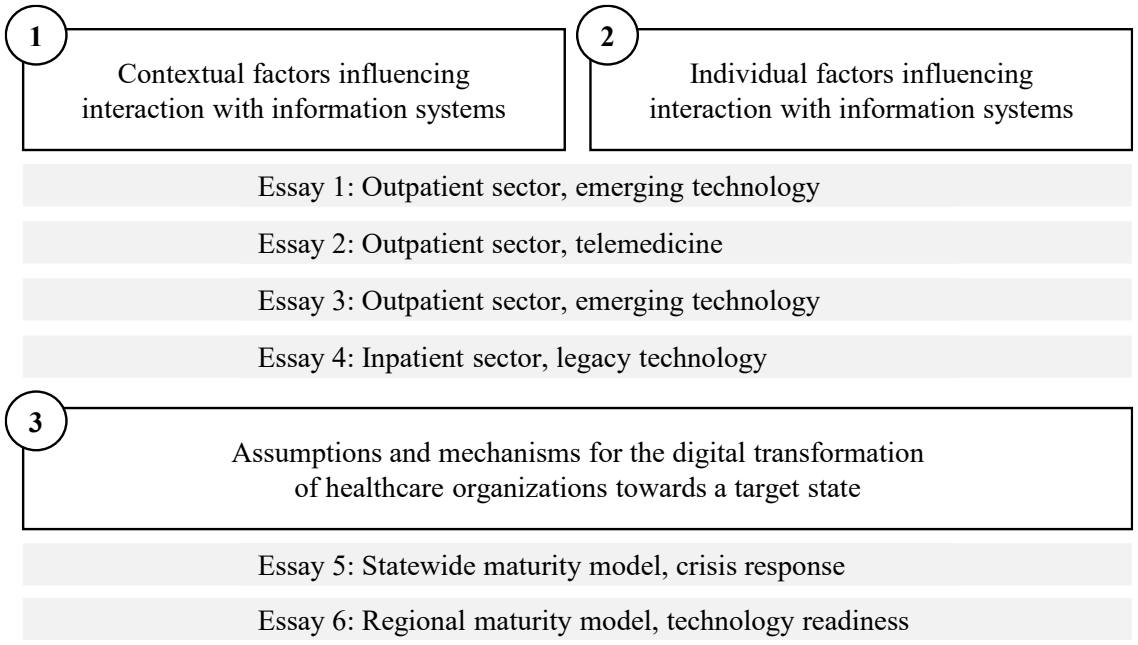
RG1: To identify and understand the environmental, organizational, and technological conditions that shape healthcare professionals' interactions regarding information systems.

RG2: To analyze relevant individual factors – including personal characteristics, technological proficiency, cognitive factors, and individual experiences – that influence health information system users' beliefs and behaviors.

RG3: To develop operational mechanisms essential for the digital transformation of healthcare organizations towards a target state.

By addressing both contextual and individual factors and developing assumptions and mechanisms for digital transformation tools, I seek to support healthcare organizations in achieving higher digital maturity levels, improved operational efficiency, and better patient care. I define healthcare organizations as a wide range of purposefully designed, structured social systems developed to deliver healthcare services by specialized workforces to specific communities, populations, or markets (Field 1973). In the complex landscape of healthcare, the interplays between various actors highlight the critical importance of collaboration and interdependence (Martin et al. 2010). Effective healthcare delivery relies not only on the individual contributions of each actor, but also on their ability to work cohesively in a networked system (Bainbridge et al. 2015). I argue that understanding and managing these interconnected relationships is essential for advancing digital transformation and achieving higher levels of efficiency and patient care. In this dissertation, I focus on medical professionals that work in outpatient physician practices (Essays 1, 2, 3) or inpatient hospital organizations (Essay 4), public health entities that protect and improve the health of populations and communities (Essay 5), and networking structures that deliver coordinated care (Essay 6). Figure 2 provides an overview of the research goals and included essays.

Figure 2: Overview over the Research Goals and the Scopes of the Essays included in this Dissertation



3.2 Overview over the Research Goals

RG1: Analyzing the Contextual Factors that Influence Healthcare Professionals' Interactions with Information Systems (Essays 1, 2, 3, 4)

The first objective is to identify and understand the contextual factors that shape interactions between healthcare professionals and ISs. This involves examining the environmental, organizational, and technological contexts that influence IS usage, which facilitate or hinder medical users in their interactions with ISs (Duncan et al. 2022). This knowledge helps healthcare professionals and organizational leaders to take informed decisions about system implementation and integration, ensuring that solutions align to specific contexts, so as to enhance usability and acceptance (Safi et al. 2018). It also aids in identifying and adjusting (technological) barriers, ensuring that the necessary infrastructure supports seamless IS integration (Krasuska et al. 2020). This understanding also allows for the development of targeted training and support programs, empowering healthcare professionals to use IS effectively and foster an organizational culture beneficial to digital transformation (Hall et al. 2015). In summary, integrating contextual factors into the study of human-IS interactions ensures that solutions are contextually relevant, user-centered, and strategically aligned to organizational goals, leading to more successful and sustainable digital transformation initiatives. Ultimately, by addressing these contextual factors, healthcare organizations can

accelerate their digital transformation journey, leading to higher digital maturity levels, improved operational efficiency, and better patient care.

Following this claim, in this dissertation, I *analyze contextual factors that influence healthcare professionals' interactions with ISs* (RG1) and deliver common dimensions that trickle down to the behavioral level of healthcare professionals, who are the end-users of these ISs; organizations must keep these in mind when managing digital transformation.

RG2: Analyzing the Individual Factors that Influence Healthcare Professionals' Interactions with Information Systems (Essays 1, 2, 3, 4)

Hand in hand with contextual considerations, RG2 seeks to identify the relevant individual factors that shape health IS users' behaviors, with a focus on the medical professionals, as these providers' work ethos tends to emphasize patient wellbeing, ethical principles, and a commitment to care (Meskó and Spiegel 2022; Rothstein 2010). Individual factors include personal characteristics, technological proficiency, cognitive factors such as beliefs and attitudes towards IS, and individual experiences with technology (Ashtari and Bellamy 2019; Buck et al. 2022). Understanding these individual factors is crucial for facilitating digital transformation, as it provides a detailed view of the personal conditions that affect IS usage, especially since beliefs and behaviors are often based on the patient's medical well-being, even if this conflicts with the interests of digital transformation (Ruiz Morilla et al. 2017). Addressing these factors allows organizations to describe supportive policies, identify cognitive barriers, and provide necessary resources for smooth IS adoption. I argue that, by reflecting on individual factors, organizations can create IS solutions that meet healthcare professionals' needs, enhancing system acceptance and sustained usage. This approach fosters a culture that values effective IS use. In summary, understanding the determinants of beliefs, attitudes, acceptance, and de facto behaviors is vital in the human-centered service domain of healthcare, because it directly impacts on the effectiveness, efficiency, and success of ISs. This understanding ensures that systems are user-friendly, widely adopted, and ultimately contribute to better patient care and operational efficiency.

Thus, this dissertation adds *individual factors that influence healthcare professionals' interactions with ISs* (RG2) and emphasizes the dominant impacts that humans have on successful digital transformation, especially in a service domain such as healthcare.

RG3: Operational Mechanisms for the Digital Transformation of Healthcare Organizations towards a Target State (Essays 5, 6)

Building on both contextual and individual factors, RG3 aims to develop operational mechanisms that organizations need to consider for successful digital transformation, guiding them through the complexities of digital transformation with a strong emphasis on the human factor. Given the highly contextual and individualistic nature of MMs (as noted by Becker et al., 2009; Bruin et al., 2005), I do not suggest a one-size-fits-all solution. Instead, I provide crucial considerations for healthcare organizations to either transfer or develop their own purpose-built tools, specifically MMs, or to use the previously detailed dimensions as strategic guardrails. The key here is viewing the process as a holistic, human-centered activity, ensuring that MMs are not merely technical frameworks but are aligned to the unique needs and behaviors of the healthcare professionals who will use them. The findings aim to help healthcare managers design strategies and practices that make IS use contextually relevant, aligning with the specific operational realities of healthcare settings. Thus, the transformation strategies will fully integrate the human and contextual aspects, increasing the likelihood of successful digital transformation and avoiding common pitfalls. Ultimately, the goal is to support healthcare organizations in navigating their digital transformation journey with clarity and purpose, leading to improved patient care and operational efficiency.

Thus, this dissertation delivers *operational mechanisms that are essential for the digital transformation of healthcare organizations towards a target state (RG3).*

4 Research Methods

This cumulative dissertation uses method triangulation to strengthen the findings' validity and reliability, providing a richer, more comprehensive understanding of the complex phenomena studied. This approach mitigates the limitations of individual methods and levers their strengths, resulting in robust and actionable insights (Jick 1979). Method triangulation provides a holistic view of the research problem, capturing different dimensions and aspects that a single method may miss. The method triangulation approach reduces the risk of biases inherent in any single method, increasing the findings' validity and painting a holistic and contextual picture of the subject of interest (Jick 1979; Podsakoff et al. 2003).

My research goals are to analyze the contextual factors and individual factors that influence medical personnel in their relationships with ISs, and to develop operational mechanisms essential for the digital transformation of healthcare organizations towards a target state. Whenever foundational understandings are needed and gaps in existing knowledge need to be identified, this cumulative dissertation includes systematic or structured literature reviews (Webster and Watson 2002). The reviews synthesize existing research and provide context for both the qualitative and quantitative findings, enabling cross-validation and a more robust analysis. Qualitative methods such as interviews and focus groups allow for a deep exploration of the determinants of attitudes, adoption decisions, and behavior antecedents, providing rich, contextual data that reveal underlying motivations and barriers (Myers 2019; Myers and Newman 2007). For triangulation purposes, quantitative methods such as surveys enable the measurement of the extents and impacts of acceptance factors, allowing for statistical analysis and generalization of findings across larger populations (Olsen 2004). Adding to this understanding, design science research (DSR) focuses on creating and evaluating artifacts, such as an instrument for digital transformation, through iterative cycles of design, implementation, and evaluation (Hevner et al. 2004). This ensures that the developed instrument is both theoretically sound and practically applicable, grounded in insights from both the literature and real-world applications. This process involves various methodological approaches and data collection methods, including literature reviews, interviews, focus groups, self-assessments, and surveys, ensuring that the artifacts are grounded in both theory and practical application.

To ensure that each method is fit for individual topics and publications as well as to contribute effectively to overall triangulation, a careful and systematic approach is employed. Each method is meticulously chosen based on its ability to answer specific research questions and

the overall research goals. Rigorous methodological practices, such as purposive sampling and thematic analysis for qualitative studies (Etikan et al. 2016), and validated instruments and statistical techniques for quantitative studies (Boudreau et al. 2001), ensure each method's robustness. Iterative feedback and peer review processes further ensure the chosen methods' appropriateness and effectiveness (Jick 1979). Thus, the triangulated approach provides a holistic view, reduces biases, increases the findings' validity, and ensures that the RGs are addressed comprehensively, resulting in robust and actionable conclusions. Table 2 provides and overview of the essays' contexts, methods, and data.

Table 2: Overview over the Essays' Contexts, Research Methods, and Data

Essay (#) and research goal	**Sector and context**	**Research methods and incorporated data**
(1) *General Practitioners' Attitudes Toward Artificial Intelligence-Enabled Systems: Interview Study* (RG1, RG2)	Outpatient sector: attitudes towards AI (general physicians)	Qualitative interview study: • 18 semi-structured interviews with general physicians from Germany (Myers and Newman 2007; Schultze and Avital 2011) • Grounded theory methodology (Corbin and Strauss 2015; Glaser and Strauss 2017)
(2) *Examining Supporting and Constraining Factors of Physicians' Acceptance of Telemedical Online Consultations: A Survey Study* (RG1, RG2)	Outpatient sector: acceptance of telemedicine (general and specialized physicians)	Quantitative survey: • Model development and assessment of validity and reliability (J. R. Wood and L. Wood 2008; Moore and Benbasat 1991) • Survey of 127 physicians from Germany • Structured equation modeling (Hair et al. 2017), partial least square-method, mediation analysis (Zhao et al. 2010)
(3) *Enabling Physicians to Make a Sensible Adoption-Decision on Artificial Intelligence Applications in Medical Imaging Diagnosis* (RG1, RG2)	Outpatient sector: adoption of AI (radiologists and AI experts)	Systematic literature review: • Literature inclusion of 19 articles (Webster and Watson 2002) • Thematic analysis (Bandara et al. 2015) Qualitative interview study: • 14 semi-structured interviews with AI practitioners and experts from Europe and Australia (Myers and Newman 2007; Schultze and Avital 2011)
(4) *A Systematic Literature Review on Antecedents of Workarounds Related to Information Systems in*	Inpatient sector: use of HISs (hospital nurses and specialized physicians)	Systematic literature review: • Literature inclusion of 17 articles (Webster and Watson 2002) Qualitative interview study:

Hospitals & Antecedents of Workarounds Related to Hospital Information Systems: Interview Study (RG1, RG2)		• 26 semi-structured interviews with nurses and physicians from Germany and the U.S. (Myers and Newman 2007; Schultze and Avital 2011) • Grounded theory methodology analysis (Corbin and Strauss 2015; Glaser and Strauss 2017)
(5) *A Maturity Model for Assessing the Digitalization of Public Health Agencies: Development and Evaluation* (RG3)	Public health sector: digital maturity of public health agencies	Maturity model artifact development: • DSR approach (Kuechler and Vaishnavi 2008; Sonnenberg and Vom Brocke 2012), maturity model development procedure (Becker et al. 2009) • Literature inclusion of 150 articles (Vom Brocke et al. 2009) • Semi-structured interviews with 58 health agency practitioners and three Q&A workshops with 250 to 300 public health agency practitioners (Corbin and Strauss 2015) • Evaluation of design artifacts with 34 self-assessment survey responses and 15 observational interviews with public health agency practitioners (Sonnenberg and Vom Brocke 2012)
(6) *Reconsidering the Promise of Digital Transformation – Navigating Maturity in Heterogeneous End-Of-Life Care Networks* (RG3)	Regional palliative and hospice networks: digital maturity and readiness	Maturity model artifact development: • DSR approach (Hevner et al. 2004), Maturity model development procedure (Becker et al. 2009; Bruin et al. 2005; Myers 2019) • Literature inclusion of 22 articles (Webster and Watson 2002) • 8 focus group interviews with 22 network coordinators (Myers and Newman 2007) • Evaluation of design artifacts with self-assessments and two consensus workshops (Becker et al. 2009)

5 Main Results

In this chapter, I introduce the results of seven research articles combined in six essays regarding contextual and individual factors that determine the interactions between healthcare professionals and ISs as well as MM development processes. As these essays are joint efforts with co-authors and partially stem from state-level funding activities, I use *we* in Section 5.1. and 5.2.

5.1 Contextual and Individual Factors that Influence Interactions between Healthcare Professionals and Information Systems

In this chapter, I present four essays that focus on contextual and individual factors that determine the interactions between healthcare professionals and ISs, answering RG1 and RG2.

Essay 1 – *General Practitioners' Attitudes Toward Artificial Intelligence-Enabled Systems: Interview Study* – aims to understand general physicians' attitudes towards AI-enabled systems in medical diagnosis, given their crucial role as the first point of contact in the healthcare system and their responsibility for initial diagnoses, which significantly impact on patient outcomes and healthcare costs. It contributes to a better understanding of individual factors of GPs' attitudes, detailed into concerns, expectations, and minimum requirements of AI-enabled systems, as well as conditional individual characteristics and environmental influences, which are crucial for developing and implementing suitable AI-enabled systems.

Essay 2 – *Examining Supporting and Restraining Factors of Physicians' Acceptance Regarding Telemedical Online Consultations* – brings forth key drivers and barriers that explain the intentions to use telemedical online consultations by physicians, which can harmonize healthcare inequalities across regions. Our study explains physicians' behavioral intentions to use online consultations, and we identified IT anxiety and data protection-compliant technological integration as key individual and contextual factors, raising the question how to appropriately lower concerns in physicians when introducing telemedicine.

Essay 3 – *Enabling Physicians to Make a Sensible Adoption-Decision on Artificial Intelligence Applications in Medical Imaging Diagnosis* – examines measures that prioritize supporting physicians in their tasks rather than adopting technology for its own sake, empowering them to take informed decisions about the adoption of AI applications. This essay contributes to the adoption research stream through a comprehensive overview over specific measures and how these can address the known barriers to users' adoption of AI applications in medical diagnosis.

Essay 4 – *A Systematic Literature Review on Antecedents of Workarounds Related to Information Systems in Hospitals & Antecedents of Workarounds Related to Hospital Information Systems: Interview Study* – is composed of two articles that build upon each other. This essay studies workarounds, which indicate a mismatch between ISs, defined processes, and user needs, from a behavioral perspective. This research provides the structures and categorizes the direct causes and influencing factors (both contextual and individual) that precede workarounds performed by medical personnel, and lays the foundation for an understanding of users' deviant behaviors and effective prevention strategies.

5.1.1 Essay 1: *General Practitioners' Attitudes Toward Artificial Intelligence-Enabled Systems: Interview Study*

The study is set against the backdrop of the increasing prevalence and potential of AI in various sectors, including healthcare (Davenport and Kalakota 2019). AI-enabled systems are promising tools to enhance the quality and efficiency of medical diagnosis, especially in primary care (Bryan and Boren 2008; Davenport and Kalakota 2019). General physicians (GPs) are the first medical point of contact and must diagnose swiftly under uncertainty, necessitating innovative and reliable decision-making approaches in GP care (Police et al. 2010). A crucial factor for the successful adoption of AI-enabled systems is physicians' attitudes, which influences their evaluation of these systems (Eagly and Chaiken 1993). The main aim is to understand GPs' attitudes towards AI-enabled systems in medical diagnosis, given their crucial role as the first point of contact in the healthcare system and their responsibility for initial diagnoses, which significantly impact on patient outcomes and healthcare costs. Thus, we ask:

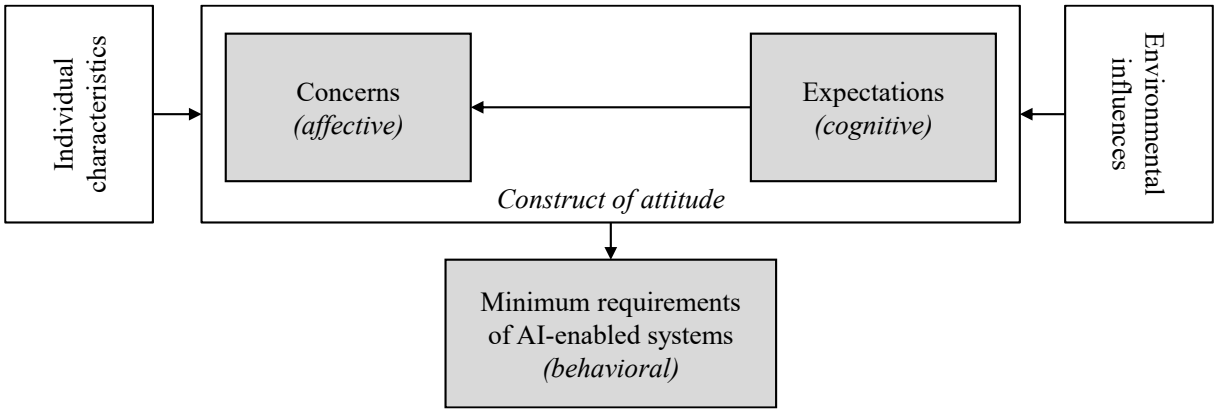
RQ1: Which determinants influence general physicians' attitudes towards AI-enabled systems in diagnosis?

The theoretical foundation is built on the *attitude* construct, understood as a psychological tendency expressed by evaluating a particular entity with some degree of (dis)favor (Eagly and Chaiken 1993; Rosenberg et al. 1960). The three-component model of attitude was adopted, comprising affective, cognitive, and behavioral dimensions. The affective component aims at emotional reactions towards AI-enabled systems, while the cognitive component involves beliefs and knowledge about these systems, and the behavioral component relates to the intention to use them (Bagozzi and Burnkrant 1979a, 1979b). Traditional technology acceptance models such as the UTAUT are criticized and extended by incorporating qualitative insights to capture detailed, emotion-driven responses from GPs, who have limited practical

experience with AI in clinical settings (Hirschheim 2007; Venkatesh et al. 2003). In-depth insights are essential to identify the determinants of GPs' attitudes towards AI-enabled systems in diagnosis. To gather this information, qualitative methods were employed to comprehensively explore GPs' attitudes (Myers and Newman 2007; Nelson 2017; Schultze and Avital 2011). An iterative process led to the identification of 307 open codes, which were further distilled into 21 concepts and five main categories: concerns, expectations, environmental influences, individual characteristics, and minimum requirements of AI-enabled systems.

Concerns were prominent, with GPs expressing existential anxiety – the fear that AI could replace their expertise and alter physician-patient relationships. Interpersonal interaction is crucial to GPs who believe AI-enabled systems lack the ability to effectively incorporate key individual aspects gained through these relationships. They also worry about data misuse and diagnostic biases. **Expectations** were mixed, with GPs acknowledging AI's potentials to improve diagnostic quality and efficiency but remaining skeptical about legal liabilities and the system's ability to replicate human competencies. **Environmental influences** – such as changing working conditions, stakeholder influences, media representation, and information technology infrastructure – significantly shaped GPs' attitudes. For instance, while demographic changes and evolving disease spectrums necessitate the adoption of AI, inadequate IT infrastructure poses a challenge. **Individual characteristics** such as age and technological affinity influenced attitudes, with younger GPs and those more familiar with technology generally being more open to AI. Lastly, GPs emphasized **minimum requirements**; that AI systems must be time-efficient, ensure diagnostic quality, guarantee data security, be economically viable, maintain transparency, and support physician autonomy if they are to be considered for adoption. We also identified relationships among these categories. For the proposed model, see Figure 33.

Figure 3: Model of the General Practitioners' Determinants of Attitudes Toward AI-Enabled Systems (Essay 1)



From a theoretical perspective, this study contributes to the understanding of attitudes towards technology by highlighting the importance of the affective component in GPs' attitudes towards AI, an often-neglected area in well-known theories of behaviors and acceptance research (Davis et al. 1992; Kulviwat et al. 2007; Venkatesh et al. 2003). The findings suggest that attitudes are not merely based on cognitive assessments, but are significantly influenced by emotional responses and contextual factors, consistent with the two-component model of attitude (Bagozzi and Burnkrant 1979a). Practically, this study provides actionable insights for developers of AI-enabled systems, policymakers, and healthcare stakeholders. To facilitate the adoption of AI in primary care, these systems must address GPs' concerns and must meet their specified minimum requirements. Diagnostic quality and time-efficiency are the most crucial requirements for AI-enabled systems. A user-centered design that aligns with GPs' attitudes and needs enhances the adoption and the effective uses of AI systems in clinical practice.

Practically, the study provides actionable insights for developers of AI-enabled systems, policymakers, and healthcare stakeholders. The need for a user-centered design approach that integrates GPs' attitudes and needs is underscored, enhancing their willingness to adopt and effectively use AI systems in clinical practice. Promoting AI among politicians, policymakers, health associations and GP stakeholder institutions can improve GPs' AI literacy. These institutions should offer education on AI-enabled systems, informing users about the technology's potentials and limitations based on evidence. Politicians, policymakers, health insurance companies, and self-governing institutions need to call for monetary subsidies aimed at enhancing physicians' willingness to use and engage with technologies. AI is not a one-size-fits-all technology, and it should be used thoughtfully and resourcefully. Understanding and integrating user groups' attitudes and needs is essential for user-centered design, increasing

adoption and everyday use. Our findings can guide the design of AI-enabled systems that free GPs' time, allowing them to better nurture relationships with patients, which is crucial for effective diagnosis in GP care.

5.1.2 Essay 2: *Examining Supporting and Constraining Factors of Physicians' Acceptance of Telemedical Online Consultations: A Survey Study*

Owing to numerous social and demographic changes, the outpatient sector is experiencing ongoing and substantial healthcare inequalities, particularly between urban and rural areas (Tetzlaff et al. 2017). The rising demand for healthcare services stands in sharp contrast to the available medical staffing levels. The shortage of physicians exacerbates challenges in rural areas, resulting in greater distances between providers and patients, longer wait times, and fragmented care (Ricketts 2013; Streeter et al. 2017). Thus, physicians are under strong pressure as the intensity and speed of demand surpass their expertise, skills, working hours, and geographic reach (Bashshur et al. 2016). It is therefore crucial to incorporate digital technologies to address the isolated communication as well as to leave paper-based documentation behind (Hufnagl et al. 2019) and bridge geographical gaps, thereby addressing regional structural weaknesses (Bashshur et al. 2016). Telemedicine approaches such as online consultations offer potentials to enhance efficiency and expand the delivery of care beyond siloed healthcare facilities (Bashshur 1995). In this essay's specific setting of online consultations, patients are seen by a physician via a direct and secure video and audio connection, while also accessing the corresponding digital patient file on a digital platform. For these technologies to be successfully implemented, it is important to understand the factors that support or constrain their use (Almathami et al. 2020). This essay focuses on the physician perspective so as to identify the factors that support or constrain the acceptance of telemedical online consultations, and ultimately, the behaviors regarding telemedicine in outpatient care. Thus, we ask:

RQ2: What are the supporting and constraining factors that influence physicians' intention to use the telemedical application of online consultation?

We created a model on the intention to use telemedical applications such as online consultations, based on the well-known, acceptance research foundation of UTAUT (Venkatesh et al. 2003), and we incorporated the antecedents of performance expectancy, effort expectancy, and social influence (Ajzen 1991) as well as compatibility (Moore and Benbasat 1991), IT anxiety (Venkatesh 2000), and the importance of data security (Dünnebeil et al. 2012) on

behavioral intention. We surveyed physicians in Germany. The results indicate that performance expectancy, effort expectancy, and social influence strongly impact on the intention to conduct online consultations. Structural conditions regarding data security are a key determinant, related to performance expectancy and effort expectancy. We find that IT anxiety predicts performance and effort expectancy, while performance expectancy fully mediates the direct relationship between IT anxiety and the intention to use telemedical applications.

We identified key drivers and barriers that explain the intention to use online consultations. All our theorized supporting and constraining factors are linked to the intention to use online consultations, regardless of compatibility. We built on UTAUT (Venkatesh et al. 2003) and expanded its framework to include these factors, confirming performance expectancy and effort expectancy as predictors of physicians' intention to use telemedicine. Our results also highlight the significant role of **social influence** on the intention to use, suggesting that physicians strongly depend on the subjective norms – i.e., their colleagues' opinions and behaviors – when adopting new technologies (Hao et al. 2018). Interestingly, compatibility did not significantly relate to behavioral intention, possibly owing to a general affinity with technological innovation or a lack of experience with telemedical consultations among participating physicians. Most notably, it is the **IT anxiety** – here, about telemedical online consultations – that leads to lower performance expectancy and higher effort expectancy. This implies that expectancy per se does not dissuade physicians from using telemedical applications, but the underlying anxiety that obscures their evaluation of these expectations (Tsai et al. 2019). Further, individuals' perceived importance of **structural conditions regarding data security** impact on performance expectancy (direct), effort expectancy (direct), and intention to use (indirectly). Given that physicians regularly handle sensitive data (Kim et al. 2020; Saigi-Rubió et al. 2016), they value data protection. We validate that enforced regulations and standards form the basis for the use intention of telemedical online consultation hours.

From a practical perspective, this work provides valuable insights into implementing online consultations among key stakeholders in physician-patient relationships, including physicians, patients, associations, education programs, and technology providers. It is crucial to demonstrate telemedicine's ability to meet the needs of physicians, who will only adopt these technologies if they see tangible benefits for their patients and their practice. Our findings highlight the importance of social influence, suggesting that physician associations have a vital role in promoting online consultations by acting as a key link and platform for exchange (Han

et al. 2004). Educating influential members within these associations can help drive the adoption of online consultations, particularly among physicians with little experience in telemedicine. Regular community meetings and networking events can facilitate this ongoing exchange and support group convergence (Chau and Jen-Hwa Hu 2002). To overcome IT anxiety-related obstacles, healthcare organizations and IT providers should focus on developing familiarity with telemedicine through extensive user training and promoting collaboration and knowledge-sharing among tech-savvy colleagues (Pathipati et al. 2016; Sanchez Gonzalez et al. 2019; Sapci and Sapci 2019). Clear communication about a system's operations and benefits can increase the intention to use online consultations (Ayatollahi et al. 2015). As physicians' concerns about privacy and data security can be alleviated by enforcing robust national regulations and standards (Adenuga et al. 2017; Kane et al. 2015), we call on politicians and regulatory bodies to establish the necessary framework conditions to support the introduction of telemedical applications, which increase physicians' confidence in using telemedical applications and ultimately their intention to adopt these technologies. Table 3 details the key insights and derived recommendations.

Table 3: Key Insights and Derived Recommendations for Implementing Telemedical Online Consultations (Essay 2)

Construct	**Key insights**	**Derived recommendations**
Social influence	Colleagues can model and promote the acceptance of online consultations. Physician associations facilitate opinion exchanges about online consultations.	Foster social connections and groups among physicians through meetings and networking. Educate and establish multipliers to explain and promote telemedical online consultations to reach convergence.
IT anxiety	Afear of changes in working practices, reduced performance, and increased effort can lead to IT anxiety towards online consultations.	Reduce IT anxiety by developing familiarity through user training, demonstrations, collaboration, knowledge-sharing, involvement in IT design, providing incentives, and easing administrative burdens.
Structural conditions regarding data security	Physicians are aware of sensitive patient data and emphasize the importance of compliance with data protection guidelines in online consultations.	Build confidence in telemedical consultations by enforcing national regulations, setting standards, and implementing low-entry concepts for data protection compliance.

5.1.3 Essay 3: *Enabling Physicians to Make a Sensible Adoption-Decision on Artificial Intelligence Applications in Medical Imaging Diagnosis*

As AI technology spreads relentlessly across various sectors, its transformative impacts have become undeniable. In healthcare, radiology is the discipline most actively integrating AI applications owing to its data-drivenness and the structuredness of image data (Hosny et al. 2018). AI is revolutionizing medical imaging diagnosis by enhancing diagnostic accuracy, while reducing physicians' workload. Despite these clear benefits, significant barriers remain to the widespread adoption of AI in this field (Allen et al. 2021). Existing research highlights several hindering factors: AI knowledge and literacy gaps (Buck et al. 2022), concerns of job loss and autonomy loss, inefficiencies and increased effort (Buck et al. 2021), as well as fears of diagnostic bias and data misuse (Hua et al. 2024). Addressing these obstacles requires targeted measures that support physicians in their tasks, rather than adopting technology for its own sake. It is therefore crucial to empower physicians to make well-informed decisions regarding the adoption of AI applications. Thus, we ask:

RQ3: Which measures enable physicians to take informed adoption decisions on AI applications in medical imaging diagnosis?

Drawing on the literature and enriched with interviews with experts, we introduce the following measures of enablement, enabling adoption decision measures and supporting adoption measures. **Enabling adoption decision measures** empower physicians to take informed decisions about the sensible adoption of AI applications in medical imaging diagnosis (educate physicians, adapt the medical curriculum, enable practical experience, ensure physicians' integration in technology development, provide transparency, establish role models, establish cross-disciplinary teams, show medical value, and show business value). These measures seek to increase AI literacy, understanding, trust, and perceived value among physicians, potentially lowering perceived threats and improving self-efficacy. **Supporting adoption measures** guide physicians in the adoption process after a positive adoption decision (i.e., provide an overview over AI applications and provide implementation guidelines). To increase self-efficacy, these measures provide specific guidelines for the selection and implementation of AI applications. Table 4 details the measures and their fit to influencing factors.

Table 4: Measures that Address the Influencing Factors (Essay 3)

	Category	**Influencing factors** (Hua et al. 2024)											
		Burden	Value proposition	Perceived threat	Trust	Self-efficacy	AI literacy	System understanding	Ethicality	Workflow integration	Technology receptiveness	Social influence	Organizational readiness
Enabling	Educate physicians			x	x	x	x	x			x		
	Prepare future physicians			x	x	x	x	x			x		
	Practically train physicians			x	x	x	x	x			x		
	Integrate physicians in technology development	x			x					x			
	Provide transparency				x								
	Show the medical value		x										
	Show the business value		x										
	Establish a panel of experts				x							x	
	Establish cross-disciplinary teams				x							x	
Supporting	Provide a marketplace for AI applications					x							
	Provide implementation guidelines					x							

By gaining AI knowledge and skills through workshops and practical experience, physicians will become more capable and less threatened by AI, viewing it as a partner rather than a competitor. This increased knowledge also builds trust, which is crucial, given AI's autonomy, and reduces uncertainty (Alsultan 2023; Malerbi et al. 2023). Involving physicians in AI development, establishing role models, forming interdisciplinary teams, and ensuring transparency can foster trust and facilitate integration into existing workflows (Huo et al. 2023). Physicians need to see tangible benefits from AI, such as improved quality of care, time savings, and increased revenue. Independent studies that provide evidence of these benefits are critical for adoption (Gilbert et al. 2020), while offering clear guidelines on selecting and implementing AI applications boosts physicians' confidence in using these technologies. Addressing ethics

and organizational readiness requires organizational-level interventions and adherence to regulations, which cannot be achieved solely through user-focused measures. Integrating AI into medical education and ongoing evaluations will ensure AI's lasting impacts in medical practice. This study emphasizes the need for a holistic strategy to promote effective AI adoption in healthcare, owing to the multifacetedness of technology adoption. This underscores the need for a holistic strategy that includes both individual and systemic interventions.

5.1.4 Essay 4: *A Systematic Literature Review on Antecedents of Workarounds Related to Information Systems in Hospitals & Antecedents of Workarounds Related to Hospital Information Systems: Interview Study*

HISs are designed to assist medical staff by collecting, processing, and sharing medical and administrative data (Tetzlaff et al. 2017). Successful use depends on both technologies and the organizational environment, including the specific users. When HISs are seen as obstructive and misaligned with the workflows of nurses and physicians, staff often resort to workarounds (Krasuska et al. 2020).

From a behavioral perspective, a workaround is a response to a perceived or de facto problem that an individual seeks to fix or avoid (Georgantzas and Katsamakas 2008). These behaviors often include unapproved practices not formally outlined in process models, such as skipping steps or performing unauthorized actions to achieve a goal. Workarounds indicate a mismatch between ISs, defined processes, and user needs (Halbesleben et al. 2010). Understanding why workarounds occur helps develop strategies that prevent them, ensuring safe and efficient healthcare practices.

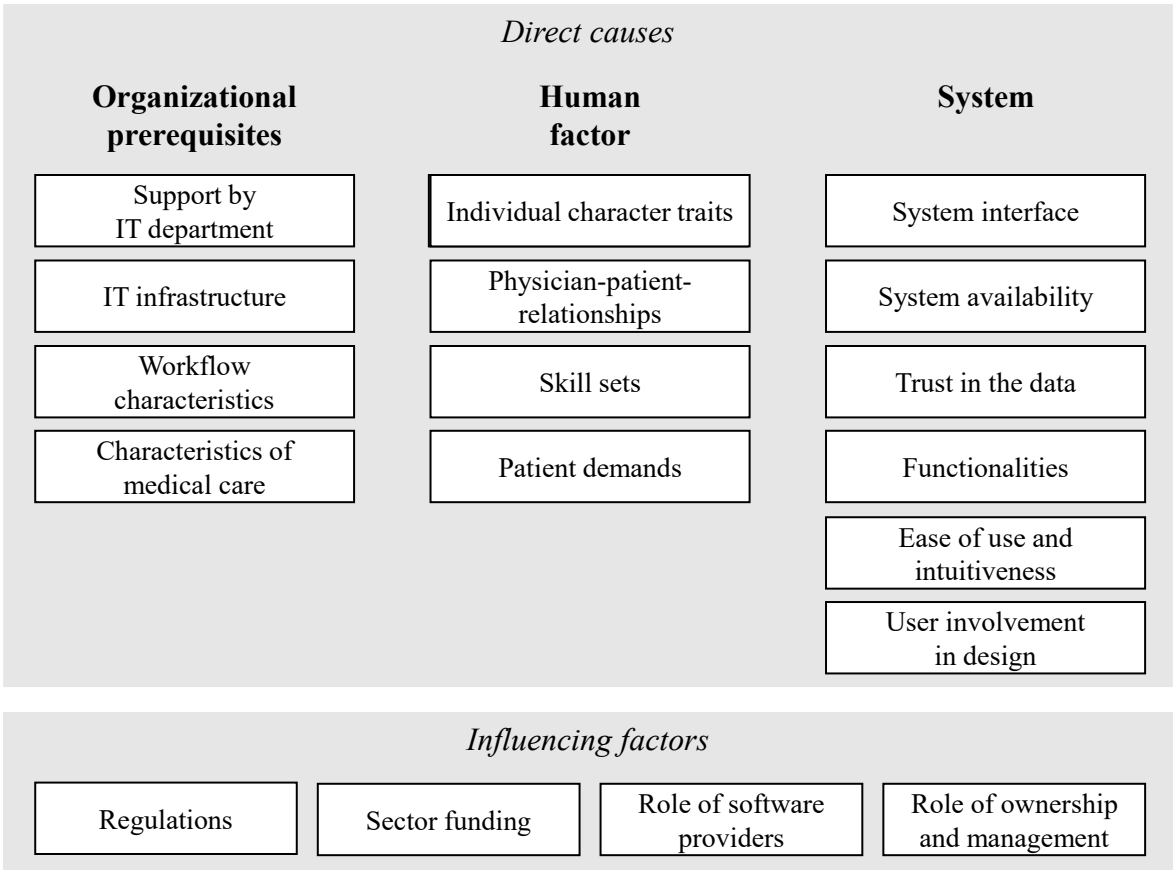
Studies have explored various theoretical frameworks for analyzing workarounds, each with its definitions and scope of behavior (Dobrzykowski et al. 2016; Rohner 2012; Rubbio et al. 2020). The Theory of Planned Behavior (TPB) suggests that the intention to perform a behavior is its direct antecedent, influenced by attitudes towards the behavior, subjective norms, and perceived behavioral control (Ajzen 1991). Soffer et al. (2023) proposed that workarounds are performed with the intention to benefit someone. In a medical inpatient context, this intention to benefit may be for the individual performing the workaround, the patient, the local unit (ward), and/or the organization. This study examines how underlying factors shape individual workaround behaviors in the context of HISs, asking:

RQ4a: What antecedents to workarounds related to hospital information systems are described in the literature?

RQ4b: How do underlying antecedents shape individual workaround behaviors in the context of hospital information systems?

To identify the antecedents of HIS-related workarounds, we conducted a structured literature search as well as semi-structured interviews. With our studies, we identified three direct causes (organizational prerequisites, the human factor, and the system) and four influencing factors (regulations, sector funding, software providers' role, the role of ownership and management) presenting the antecedents for HIS-related workarounds, as depicted in Figure 4.

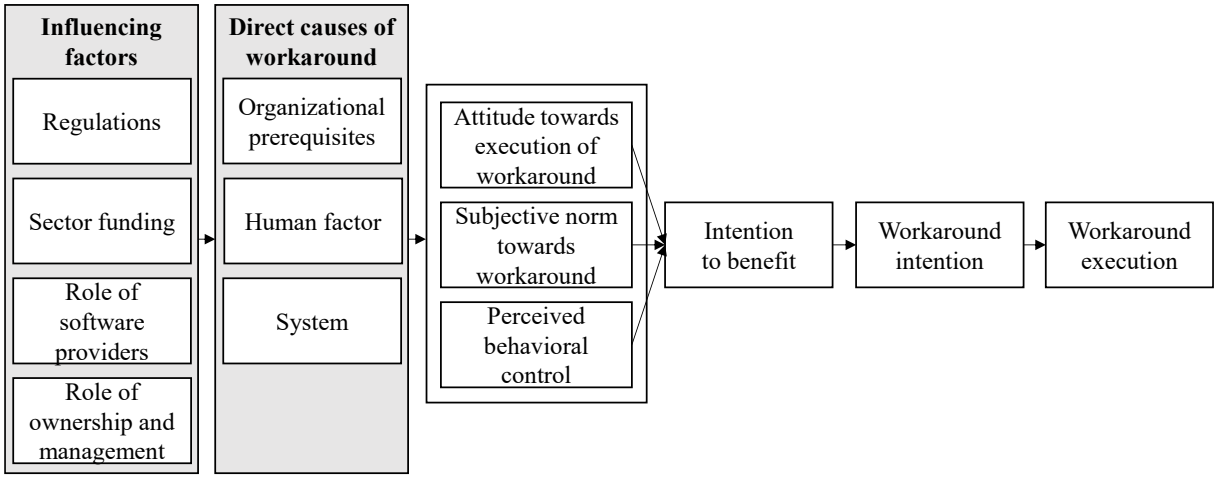
Figure 4: Overview over Categories and Concepts derived from the Interviews on HIS-Related Workarounds (Essay 4)



Our proposed model (see Figure 5) outlines a sequential process, emphasizing rationales that are antecedents of TPB constructs. The **influencing factors** we identified – regulations, sector funding, the role of software providers, and the role of ownership and management – act as second-level influences in explaining HIS-related workarounds. These higher-level factors do not directly impact on the behaviors of nurses and physicians but set the conditions for the direct

causes of workarounds. The human factor, the system, and organizational prerequisites form these **direct causes**, which then influence attitudes towards the execution of workarounds, subjective norms towards workarounds, and perceived behavioral control. The intention to benefit – whether aimed at the user, patient, local unit (ward), and/or hospital organization – leads to the workaround intention, which predicts workaround behaviors.

Figure 5: Proposed Model of Antecedents of Workarounds Related to HIS (Essay 4)



Our research contributes to theory by applying the TPB to HIS-related workarounds, offering a detailed understanding of these behaviors. It identifies specific causes and influences within the TPB framework, enhancing the theory's predictive power. Our findings also contribute to the broader literature on workarounds, deviations, and human error, stressing the importance of individual and contextual factors in shaping behaviors. Also, we support Soffer et al. (2023) in their extension of the TPB, which includes the intention to benefit in explaining behaviors and extend them to patient care contexts.

By identifying the direct causes and influencing factors of workarounds, our research aids in understanding medical staff behaviors and developing strategies to address root causes. Practically, healthcare organizations can use these findings to implement measures that improve working conditions. Our research can inspire the development of educational materials and training programs for medical staff, enhancing their skills and knowledge in the effective use of HISs. We recommend involving end-users in the development process to ensure that HISs meet their needs and are user-friendly. Further, policy-makers, healthcare self-administration, and associations can address the influencing factors, modifying the framework conditions of medical service provisions.

5.2 Operational Mechanisms for the Digital Transformation of Healthcare Organizations towards a Target State

This chapter presents two essays that focus on MM development processes, dimensions, and mechanisms, answering RG3.

Essay 5 – *A Maturity Model for Assessing the Digitalization of Public Health Agencies: Development and Evaluation* – speaks to the necessity of a strategy that promotes agreement on a shared digitalization objective and transformation paths, following the COVID-19 crisis with heightened digitalization needs. It provides dimensions of maturity with step-wise capabilities and associated practices, enabling joint negotiation processes, the allocation of funds, digital resilience, and preparation for future crises.

Essay 6 – *Reconsidering the Promise of Digital Transformation – Navigating Maturity in Heterogeneous End-Of-Life Care Networks* – develops and presents a standardized framework to guide systematic progression and improve cooperation among network partners, emphasizing the roles of contexts and operationalization in accommodating the developmental progress of all networks, regardless of their digital readiness.

5.2.1 Essay 5: *A Maturity Model for Assessing the Digitalization of Public Health Agencies: Development and Evaluation*

Locally-operating public health agencies (PHAs) had a key role in managing the COVID-19 pandemic, providing vital health services. Besides essential routines such as administering medical services and tracking infections, PHAs are central information hubs, promoting health through counseling and education about preventive measures and offering care information, such as nursing services (Rechel et al. 2018). The COVID-19 crisis impacted society as an "extreme, unexpected or unpredictable event" (Doern et al. 2019, p. 3), prompting rapid action across the individual, organizational, and societal levels (Dutton 1986). Particularly the task of contact tracing, which is crucial for controlling COVID-19 (Robert Koch-Institut 2016, 2020), strained PHAs' limited personnel and IT resources, and the federal structure led to fragmented organizational frameworks, diverse technical facilities, and regional laws, reducing PHA efficiency and the stakeholders' cooperation (Gruhl 2020). Digitalizing PHAs to meet the needs of both employees and citizens is challenging in this decentralized system, causing delays and inefficiencies (Dunleavy et al. 2006). Harmonizing technical solutions across regions requires consensus among federal decision-makers, increasing resource demands and coordination

complexities. Achieving digital resilience, the ability to recover from disruptions using ISs (Boh et al. 2020), is essential for the levering of synergies, for coordination purposes, and for significant efficiency gains (Dunleavy et al. 2006). While the research suggests that centralized IT could improve governmental performance (Denford et al. 2020), the structurally-based consensus mechanisms hinder technological progress and digital resilience (Dunleavy et al. 2006).

Directing the digitalization of PHAs in a federally-managed context necessitates a strategy that promotes agreement on a shared digitalization objective and transformation path. MMs are a well-established IS method that helps create a clear vision and outlines progressive steps to achieve it (Becker et al. 2009; Mehta et al. 2007; Subba Rao et al. 2003). To enhance digital resilience and prepare for future crises, federal and state governments have set goals involving an artifact designed to evaluate the digital maturity of PHAs in Germany. These goals aim to boost PHAs' digital resilience, minimize structural disparities among PHAs, and allocate national funds more efficiently. Thus, we ask:

RQ5: How can federally-managed public health agencies, which must also operate in crises, mature digitally?

To achieve these objectives and facilitate PHAs' digital maturity, we employed a coordinated strategy to create and assess a MM for the systematic digitalization of federally-managed PHAs within a feasible timeline. The Public Health Agency Maturity Model (PHAMM) seeks to enhance the digital maturity of federally-managed PHAs by providing eight dimensions: digitalization strategy, employees, process digitalization, IT security, IT provision, citizen focus, cooperation as well as software, data, and interoperability. It seeks to define a shared digitalization vision for PHAs and outline steps towards this goal, ensuring applicability for many federally structured PHAs to boost digital resilience. It also seeks to reduce structural differences between PHAs and facilitate the allocation of national funds at the federal level. In the following, Table 5 details the dimensions and subdimensions of the model.

Table 5: Dimensions and Subdimensions of the PHAMM (Essay 5)

Dimension	Description, including subdimension
Digitalization strategy	This dimension comprises (1) the definition, communication, and implementation of the digitalization strategy, (2) the definition of responsibilities, and (3) the planning of the necessary digitalization budget for the PHA's tasks and objectives.
Employees	This dimension includes (1) the sensitization and (2) participation of the employees in digitalization activities, and (3) the training possibilities.
Process digitalization	This dimension includes (1) the extent to which processes are documented, (2) the extent to which processes are supported by ITs, and (3) the extent to which there are overlapping processes to be addressed via cross-process coordination. Finally, we lay out criteria for the (4) evaluation of processes across tasks and departments.
IT security	This dimension includes (1) the scope of IT security management, and addresses concrete measures for (2) dealing with IT security risks and attacks as well as (3) identity and access management.
IT provision	This dimension includes (1) the equipment of the IT workplace (hardware and operating systems), (2) the organization of the IT procurement, (3) the organization of the IT infrastructure, and (4) the application of IT service processes.
Citizen focus	This dimension includes the consideration of (1) interactions with citizens and (2) the orientation and design of the available information preferences.
Cooperation	This dimension includes (1) cooperation within public health departments, (2) cooperation between health departments and with provincial offices, and (3) cooperation with external stakeholders.
Software, data, and interoperability	This dimension includes the (1) use of specialist applications as well as their (2) technical interoperability, (3) data analysis and reporting, (4) requirements and documentation of specialist applications, and (5) the protection of data.

Our PHAMM has five maturity levels, with more than 350 practices, ranging from level 0 to 4, with level 4 representing the digital maturity goal for PHAs. This complex process involves the step-wise development of capabilities through the implementation of practices and concrete digitalization projects at every level. PHA managers must identify their current digital maturity by declaring fulfilled practices and then specifying their desired maturity, prioritizing practices for near, intermediate, and future implementation to formulate digitalization projects. The PHAMM fosters necessary discussions in a **joint negotiation process**, leading to commitments from institutions at various levels in the federal system. It supports this process by reflecting

the overall goal and the steps to achieve it, aiding PHAs in digitalizing through concrete practices and **enabling the allocation of funds** for implementation.

For theory and methodology, this work contributes to the literature on MM development by integrating various stakeholders in a mixed-method approach, jointly negotiating a digitalization goal and the steps towards it. The developed MM is being utilized by more than 350 organizations, addressing the need for a consensus-building approach in federal systems, unlike existing MM fundamentals. This approach suits digitalization efforts in other federal areas, such as education and disaster protection. We have formulated adaptation potentials and lessons learned for Becker et al.'s (2009) procedure model, applicable to other public sectors such as citizen services, universities, schools, and employment services (Olphert and Damodaran 2007).

Practically, our PHAMM can guide PHAs' digitalization processes, ensuring that employees can deliver value to citizens, even during crises. It significantly contributes by coordinating digitalization efforts at the national level and assessing and enhancing digital maturity at the federal level. As a coordination tool, it facilitates the sharing of experiences throughout the digitalization process and can be adapted to other countries with minor procedural adjustments. The PHAMM dimensions offer a starting point for defining shared aspirations, though practices may need adaptation based on the MM's overall objectives.

5.2.2 Essay 6: *Reconsidering the Promise of Digital Transformation – Navigating Maturity in Heterogeneous End-Of-Life Care Networks*

Forming networks is a strategic response to evolving societal and regional demands, especially in healthcare, where sectoral segmentation presents significant challenges (Mercadante 2022). Networks involve long-term collaborations among organizations to achieve shared objectives. Enhanced collaboration and resource-sharing improve prevention and healthcare services, generating synergies that provide competitive advantages, reduce risks, and save costs (Morley and Cashell 2017). In end-of-life care, regional hospice and palliative care networks (RHPNs) often emerge from independent initiatives (Herbst et al. 2021). Various care providers – including general practitioners, nursing services, interdisciplinary teams, hospitals, hospices, outpatient hospice services, pharmacies, pastoral caregivers, and social workers – collaborate to improve the quality of life of patients and families on physical, social, and spiritual levels (Wittenberg-Lyles et al. 2010). Network members also support one another emotionally in this challenging environment (Gómez-Urquiza et al. 2020). Integrating IT solutions such as

electronic health records, telemedicine platforms, and communication tools streamline information exchange and coordination, boosting efficiency (Gillum 2013). However, diverse organizational structures, sizes, legal frameworks, service offerings, and digitalization efforts create regional disparities (Radbruch and Payne 2011). Some networks excel, leading to varied experiences in the accessibility and personalization of care (Herbst et al. 2021). These disparities challenge the principles of equitable care and, for patients nearing the end of their life, the urgent need for comfort, emotional support, and symptom management outweighs the ability or necessity to compare hospice care providers and network structures (Tobin et al. 2021).

RPHNs' unsystematic expansion presents a critical need for a standardized framework to guide systematic progression and improve cooperation among these networks. This essay highlights that efficient RHPNs enhance collaboration between network partners, positively impacting on information flows and reducing the burdens of managing end-of-life care. The aim is to create a cohesive and consistent landscape that optimizes end-of-life care for terminally ill patients through structured network management and collaboration (Schwabe et al. 2023). In this context, a MM is utilized across various domains for the systematic assessment and enhancement of entities' capabilities and competencies, and potentially as a way of evaluating and incentivizing networks. MMs describe stages or levels of maturity for certain categories and outline a progression path, with distinct characteristics for each stage (Becker et al. 2009; Bruin et al. 2005). This approach is particularly relevant in addressing RHPNs' heterogeneousness, providing a structured path for continual capability development and improvement in the quality of care. This essay incorporates perspectives on MM development provided by Becker et al. (2009) and Bruin et al. (2005), and follows the DSR paradigm (Hevner et al. 2004), emphasizing the roles of contexts and operationalization in accommodating the developmental progress of all RHPNs. Thus, we ask:

RQ6: How can heterogeneous regional palliative and hospice networks assess their maturity levels along key dimensions and evolve towards defined target states?

The study identifies and delineates six key maturity dimensions, each involving several subdimensions: coordination, construction and expansion, infrastructure, external image and information exchange, further education and training, and the development of regional care services (see Table 6). These dimensions provide a structured approach for assessing RHPNs' maturity levels and navigating towards defined target states.

Table 6: Dimensions and Subdimensions of the RPHN MM (Essay 6)

Dimensions	**Subdimensions**
Coordination	This dimension comprises (1) the role of the network coordinator, (2) the roles of the network partners, (3) topic and agenda setting, (4) the structure of network meetings, (5) the organization of network meetings, and (6) the information flows.
Construction and expansion	This dimension encompasses (1) the identification and contacting of network partners, (2) the admission procedure, (3) the identification of network partners' needs, (4) goal-setting, (5) and the regional catchment area.
Infrastructure	This dimension defines (1) data storage and information distribution, (2) financing, (3) and the legal form.
External image and information exchange	This dimension encompasses (1) a target group focus, (2) the development of joint material, (3) joint design and identity, (4) the reach and effectiveness of public outreach, (5) public relations channels, and (6) cooperation with external bodies.
Further education and training	This dimension incorporates (1) the identification of further education and training needs, (2) the organization of further education and training, and (3) the financing and subsequent evaluation of further education and training.
Development of regional care services	This dimension includes (1) the identification of new joint projects, (2) the development and implementation of new joint projects, and (3) the evaluation of new joint projects.

The findings indicate that the MM can serve as a practical tool for self-assessment, promoting comprehensive collaboration and incremental progress within RHPNs. The model addresses the unique challenges posed by these networks' heterogeneity, ensuring equal opportunities for all network types to mature and progress (Schwabe et al. 2023). Several critical aspects are highlighted: capacity for action, directive authority, and not discriminating against network types. We identify c**apacity for action** as RHPNs' ability to implement necessary developments based on their available resources, such as money and staff. Some networks have sufficient resources to facilitate changes and progress, while others – often voluntary associations – have limited options owing to resource constraints. This variation significantly impacts on the design and applicability of MMs in these networks. Further, we conclude how **directive authority** pertains to the decision-making power within RHPNs. Some networks can make binding decisions, while others – owing to their structural makeup – can only provide recommendations rather than enforce decisions. This affects their ability to standardize practices such as software selection and licensing for compatibility. Therefore, our RPHN MM must account for these differences to ensure that it is practical and applicable across all network types. Technological or digital readiness is the extent to which RHPNs are prepared to adopt

and integrate digital solutions (Bilgiç and Camgöz Akdağ 2023). In Essay 6, this includes the availability of IT infrastructure, digital literacy among staff, and the ability to maintain and upgrade technological resources. Recognizing that not all networks have the same technological readiness level, our model promotes creative, self-reliant actions and encourages developmental progress for all networks, ensuring an inclusive approach to enhancing network maturity. The model was designed to avoid discriminating against any network type by its dimensions. It must provide a common denominator that is theoretically achievable for all networks, regardless of their structural or resource-based limitations. This ensures that no network is systematically excluded from the path of development, allowing all to progress towards their target states without facing structural obstacles. To accommodate these differences, the RPHN MM intentionally omits specific IT-related topics such as IT equipment, compatibility, software selection, and digital strategies. This omission recognizes that not every network can standardize IT or adapt their operations and infrastructure. While some RHPNs can lever digital solutions, others – particularly those relying on voluntary support – find it challenging to implement these changes. Instead, our model encourages creative, self-reliant actions and accommodates developmental progress for all networks, ensuring an inclusive approach to enhancing network maturity.

From a theoretical perspective, this essay contributes to the barely explored field of RHPN management by structuring dimensions and maturity levels, integrating real-world insights from practitioners to establish a solid foundation for assessing and advancing RHPNs. It extends the IS MM literature by emphasizing the distinctions between interorganizational (Röglinger et al. 2012) and consensus structures (Doctor et al. 2023) and adapting the model to the differences in capacity for action and directive authority, and providing a foundation to identify network types.

Practically, our RPHN MM provides a roadmap for incremental progress and promotes comprehensive collaboration, ultimately optimizing the quality of care within RHPNs. By ensuring that the model accommodates the unique operational contexts and constraints of different RHPNs, it fosters an inclusive approach to network maturity. The research underscores the importance of aligning technology development with persons' de facto needs and structural boundaries, advocating for digital solutions that facilitate equitable opportunities and informed decision-making within these networks.

6 Discussion and Contributions

6.1 Aggregated Discussion of the Results

While digital transformation is a significant advancement, it is not an end in itself. Sustainable success is only achieved when digital transformation is implemented holistically in healthcare organizations (Cresswell et al. 2013). My overarching research aim in this dissertation is to navigate medical professionals' behaviors in the successful digital transformation of healthcare organizations, especially in the human-centered medical service domain, where the value lies in service provision and the systems are sociotechnical (Rothstein 2010). To address this, the thesis draws on seven articles, combined in six essays, which focus on:

- general practitioners' attitudes towards AI-enabled systems in diagnosis (Essay 1);
- physicians' acceptance of telemedical online consultations (Essay 2);
- measures that enable the sensible adoption decision of AI in radiology (Essay 3);
- HIS-related workaround behaviors of nurses and physicians in hospitals (Essay 4);
- dimensions of maturity for the digitalization of public health entities (Essay 5); and
- dimensions of maturity for regional hospice and palliative care networks (Essay 6).

These six essays demonstrate commonalities of successful digital transformation and maturity for healthcare organizations. Following a context-sensitive approach, the results highlight that, while certain abstract principles may be consistent, their specific dimensions and implementation must be specific to the environment in which they are used. I will now provide an overview over the most prominent findings that underline the three primary research goals, which I then translate into practices (see Chapter 6.3). The commonalities are structured along the research goals as:

RG1: contextual factors that influence healthcare professionals' interactions with ISs: environmental conditions, organizational factors, and social norms;

RG2: individual factors that influence healthcare professionals' interactions with ISs in their role as providers in the organizational context: judging against resource and time constraints, the minimum requirements threshold, medical providers' professional ethos, digital literacy and knowledge, and IT anxiety; and

RG3: operational mechanisms for the digital transformation of healthcare organizations towards a target state: the maturity model's application scope, capacity for action, directive authority, joint consensus, and federal funding.

6.1.1 Contextual Factors that Influence Healthcare Professionals' Interactions with Information Systems

In terms of external factors, this thesis confirms and details **(1) environmental conditions**, **(2) organizational factors**, and **(3) social norms** that need consideration towards successful digital transformation.

Regarding existing **(1) environmental conditions** – which in the behavioral research is known as *facilitating conditions* (Venkatesh et al. 2003) – this dissertation follows the claim of high contextuality, leaving the determinants subject to the specific research settings. It highlights reimbursement's role in IS implementation and use, as exemplified for outpatient physician practices, hospitals, and healthcare networks (Essays 1, 4, 6). Adequate financial incentives are needed to offset the added efforts required during transformations (Essay 1). Thereby, establishing sufficient and appropriate medical billing codes to support sustained IS utilization and integration is reported as vital in the long run (Essay 1). There is a recognized need for reform in the way IT costs are classified and financed within the dual-financing framework. Given digital technologies' increasing importance in healthcare, one must ensure that IT expenses – especially those related to operations such as licensing fees – are appropriately funded. This may require adjustments in the financing regulations, such as redefining what constitutes operating vs. investment costs, or creating specific provisions in the Diagnosis Related Groups (DRGs) system, or other reimbursement structures to cover these IT-related expenses (Stephani et al. 2019). In outpatient settings, physicians are often both the managers of a healthcare organization (their own practice) and the users of HISs. My results indicate that they weight funding and reimbursement higher than the inpatient sector or public health entities, where the managerial implications of IS use are largely isolated from the end-users' day-to-day operations (Essays 1, 4). Further, the results show vendor lock-in effects in the software market of legacy systems. The healthcare sector is highly regulated (Essay 4), limiting the entry of new competitors, which leaves a few established vendors as compliant market dominators, reducing competitive pressures and innovation. Thus, changes in system design and functionality scope often stem from legislation, in contrast to competitive markets. Transitioning from legacy systems involves significant costs regarding time and resources, often with issues of long-term contracts, and surfaces interoperability issues, which further discourages organizations from switching vendors despite the potential benefits (Essay 4). In market niches where there is enough money (e.g., the self-payer segment), this issue is not evident (Essays 1, 3).

Regarding the influences of **(2) organizational factors**, I confirm facilitating conditions at the organizational level (Venkatesh et al. 2003). These factors shape the work system within which healthcare professionals engage with ISs (Alter 2013), including strategic and management decisions that shape daily operations and that favor an enabling or challenging work setting. Administrative and regulatory compliance requirements have a strong grip on the providers integrated into this dissertation, as healthcare facilities face the challenge of adhering to constantly changing legal regulations and standards, such as ensuring accurate and timely documentation. For instance, financial constraints can lead to the understaffing of wards in hospitals, challenging overall capacities and therefore impacting on IS use (Essay 4). This is accompanied by the (un)suitable process design and workflow characteristics and their fit to the established and planned IS landscape, where misfits favor deviant workaround behaviors (Alter 2014). This can be mitigated by directly involving users in a system's design and implementation, and by ensuring seamless system accessibility without outages (Essays 1, 3, 4). The existing IT infrastructure must meet the evolving demands of healthcare staff members, influenced by the variety of systems in use (Krasuska et al. 2020). Whether connected or not connected, multiple ISs can create information silos influenced by the level of interoperability for data exchange (Ajer et al. 2019). The variation in standardized protocols for processes and data exchange can lead to differences in care delivery and communication among healthcare providers, potentially complicating patient transfers between departments or facilities (Essay 4). For instance, if an organization provides insufficient IT infrastructure and IT support, the end-users of ISs – i.e., the medical personnel – must carry the burden of misfits between demand and capabilities, for instance by sharing log-in information in jointly used workstations or passing on habitual IS experiences (Essay 4).

This dissertation further confirms and amplifies the dominant role of **(3) social norms** in shaping individual IS behaviors, which is crucial in the technology acceptance research (Venkatesh et al. 2003). My results show social norms' influences on multiple stakeholders: media educates both the medical professionals and the public, which translates to patients and relatives (Essays 1, 2, 3); medical professional associations and governing institutions (Essays 1, 2) provide professional support and ethical backing; management, culture, and a panel of experts guide the organization in alignment with its strategy and vision (Essay 2); and finally, role models in the immediate workplace who can positively or negatively influence IS behaviors. Thus, employee connectedness fosters involvement and empowerment from the bottom up (Essays 1, 2, 3, 4). Social norms' influences are particularly important concerning

early adopters, who are quick to embrace new ideas early on but do so with caution, caring deeply about their peers' opinions and therefore influenced by the social norms in their professional circles (Rogers 2003).

6.1.2 Individual Factors that Influence Healthcare Professionals' Interactions with Information Systems

Regarding internal factors that need consideration towards successful digital transformation, this dissertation introduces certain boundaries and distinctions: **(1) judging against resource and time constraints** and **(2) a minimum requirements threshold**, **(3) providers' professional ethos**, **(4) digital literacy and knowledge**, and their relationships to **(5) IT anxiety**.

Regarding the influences of individual factors, I highlight that medical professionals in healthcare organizations are bound by and **(1) judge** their efforts **against resource and time constraints**. These constraints arise from insufficient human, organizational, and/or technological resources, leading to time pressure on medical professionals in their daily working routines (Essay 1). Thus, arguing from the perspective of operations at maximum capacity, practitioners judge (digital) transformation as burdensome, regardless of the associated time-saving potentials and the positive effects on quality of care (Essay 4). Within this constraint, there is little possibility to even engage in additional efforts. This dissertation supports the existing research, indicating that without clear, immediate benefits or sufficient support, healthcare professionals can view new technologies as additional stressors rather than as helpful tools and may therefore engage in deviant behaviors (workarounds) (Alter 2014). ISs in healthcare often primarily serve the purpose of enforcing regulatory compliance rather than effectively assisting healthcare practitioners in their clinical work. Often, if time-saving potential is not evident in the transformation process or in continued technology usages, practitioners experience a further strain on their resource and time constraints, and need to reprioritize their goals. For instance, they sacrifice their free time or lower the standards they set for themselves in providing patient-centered care (Essay 4). This is supported by studies that have shown that increased workload and time pressures can diminish work-life balance for providers, causing emotional stress, burnout, and lower performance in the delivered quality of care (Dinibutun 2020; Yu et al. 2019).

In this dissertation, I introduce the concept of **(2) a minimum requirements threshold** as a critical individual factor that influences medical professionals' interactions with ISs. The

incorporated research articles reveal that medical professionals are unwilling to even contemplate using IS (such as AI) if certain minimum requirements are not satisfied, most critically, time-efficiency and diagnostic quality (Essay 1). If digital transformation does not lead to demonstrable improvements in time strain and care outcomes but provides similar results to current methods, the established approaches will likely persist (Essay 4). This is because, despite their flaws, existing methods are already proven, tested, and do not present the challenges associated with new implementations (Essay 1). This indicates that medical professionals either require these minimum standards to be met or wholly reject considering IS. Minimum requirements often stem from IT-related concerns, for instance, the fear of data misuse necessitates robust data security measures. The only alternative for organizations to ensure interactions with ISs is by mandating them; however, this is likely to encounter significant resistance (Bhattacherjee et al. 2018).

This thesis underscores the importance of **(3) medical providers' work ethos**, which is deeply rooted in commitments such as the Hippocratic Oath, professional honor, and patient-centered obligations (Essays 1, 2). For medical professionals, I report that it is crucial to find a balanced approach to implementing and using ISs that prioritize patient care while acknowledging contextual conditions. While medical professionals act with an intention to benefit either themselves, their unit, or their organization, ultimately they have the intention to serve and benefit their patients (Essay 4). Medical providers' ethos fundamentally differs from that of business, particularly in its central focus and guiding values. Medical professionals act with a strong emotional component and an unwavering professional ethic, often during critical, life-changing moments for patients (Rothstein 2010). Based on this strong work ethos and professional obligations, this dissertation offers two key considerations: First, the results indicate that practitioners prioritize aid to patients over IS usage, including mandated IS usage (Essays 1, 4). They also include the protection of patient data, data governance, informed patient consent, and subdued use of technology (Essay 1). Second, physicians prioritize aid to patients over their own IT anxiety, given that technology is essential for providing care, especially when circumstances change, such as during a pandemic (Essay 2). Interestingly, regarding these ethical and ideological commitments, the studies likewise highlight the minimum requirement thresholds of diagnostic quality, time-efficiency, legal backing, and financial incentives (see Chapter 6.1.1), noting that practitioners would consider using ISs only when this threshold is passed (Essay 1). While diagnostic quality is an answer to benefits to patients, and time-efficiency is answered by practitioners sacrificing their free time for patients' benefit, the

introduced concept of medical honor potentially contradicts the legal backing and the financial incentive, raising the question whether legal security, economic efficiency, or ideological professional ethics prevail. Further, an informed and more demanding patient base places pressure on healthcare providers to deliver high-quality, patient-centered care tailored to individual patient needs and specific technological preferences (Stacey et al. 2009). In this context, patients are seen as customers, drawing from digitalization research terminology (Pulimamidi 2024). These findings indicate that practitioners fear deterioration in patient-physician relationships with the use of IS, as they recognize the vast benefits of emerging technologies (such as AI), which alter these relationship by shifting physician-centered tasks such as diagnosis to technology, thereby creating a separation between the provider and the patient (Essay 1). Further, mandated, time-consuming technology can take time away from patient interactions (Essay 4).

Lastly, this thesis provides a valuable confirmation of the critical importance of **(4) digital literacy and knowledge** as the most significant levers to mitigate black boxes, security concerns, and biases while simultaneously increasing trust (Essays 1, 2, 3, 4). These issues often stem from a lack of information. In this regard, **(5) IT anxiety** acts like a fog, an impediment to IS usage, by lowering performance expectancy and heightening effort expectancy (Essay 2). Addressing this requires opening black boxes to enable informed consent through enhanced literacy about the benefits, limitations, shortcomings, and risks of IS (Essay 1). Also, the medical value and the business value of digital transformation and technologies need to be effectively communicated (Essay 3). Matching this need, as described in Chapter 2.4, the MM serves as an excellent management tool, because it provides a clear, structured path, and enhances communication and formulation of a shared vision, supporting informed, realistic developments (Essays 5, 6).

6.1.3 Operational Mechanisms for the Digital Transformation of Healthcare Organizations towards a Target State

Besides internal and external factors, this dissertation introduces assumptions and operationalization mechanisms that healthcare organizations need to consider if they are to digitally transform successfully using MM: **(1) the maturity model's application scope**, **(2) capacity for action**, **(3) directive authority**, **(4) joint consensus**, and **(5) federal funding**.

Regarding **(1) the maturity model's application scope**, it is important to distinguish between inter-organizational and intra-organizational approaches to digital transformation (Essay 6).

While implementing recommendations in an inter-organizational system is controlled through centralized prioritization and resource allocation (Röglinger et al., 2012), and these assumptions impact on MM design, in collaborative healthcare structures (such as networks), there are various organizational forms, legal structures, participants, and cooperation agreements, which present substantial challenges when adopting a one-size-fits-all approach to ISs and digitalization (Head et al., 2008, Schwabe et al., 2023). Thus, MMs designed for inter-organizational applications can intentionally omit topics such as IT equipment, compatibility, software selection, and digital strategies to acknowledge the fact that not every collaborative healthcare structure can standardize IT or adapt its operations and infrastructure owing to varying strategic commitments, necessitating resource allocation by the participating organizations and entities (Essay 6). This underscores the instruments' need to accommodate the developmental progress of all organizations, regardless of their unique operational contexts and constraints, thereby fostering an inclusive approach to enhancing maturity. This call for contextualization is also met in Essay 5. By adopting this inclusive approach to enhancing maturity, these instruments seek to ensure a level playing field for digital transformation across all entities. However, this inclusive approach may also limit the potentials for some organizations to fully mature, as it must accommodate the diverse needs and capabilities of all involved. The IS research needs to nurture nuanced, contextually sensitive approaches that recognize diverse needs and boundaries yet provide adaptive IS solutions (Essay 6).

I also introduce the mechanisms of **(2) capacity for action** and **(3) directive authority**. Healthcare organizations often collaborate in various contexts to enhance the quality of care, improve patient outcomes, and streamline operations (Morley and Cashell 2017). Thereby, healthcare organizations, public health entities, and healthcare networks differ in their capacities for action and can undergo necessary developments with the (sufficient) resources available to them, while others (e.g., hospitals or public health entities) have limited funding or are a voluntary association of stakeholders (e.g., a network) (Essays 4, 5, 6). Regarding directive authority, some organizations take decisions with binding authority, while others lack such ability owing to their structural makeup and can only provide recommendations to one another (e.g., public health entities in federal collaboration, network partners) (Essays 5, 6). A model for digital transformation must be designed such that it does not discriminate against any unit in such a collaboration structure, neither by its dimensions nor by systematically excluding anyone from the path of development. Our results emphasize that maturity dimensions must represent a common denominator, and the levels must be theoretically achievable for all without

structural obstacles standing in the way (Essay 6).

Typically, MMs seek to build an understanding of the as-is and to-be digital maturity of one or various organizations that operate in similar contexts (Becker et al. 2009). However, whenever substantial structural differences exist that impede the formulation of a unified vision for multiple healthcare organizations in their to-be digital maturity, a collaborative approach is needed so as to get a **(4) joint consensus**. This dissertation demonstrates how MMs can be utilized as a democratic negotiation tool and steps towards maturity, for instance in a federal setting (Essay 5) and a regional one (Essay 6), also supporting necessary discussions leading to a commitment by institutions operating at different maturity levels. This dissertation indicates that a top-down decision-making approach is ineffective for achieving a centralized and shared goal, highlighting that MMs can guide reflections on the overall goal (the highest maturity level). Based on this, steps towards it and amended requirements are set while allowing room for individual realization approaches. This joint commitment enhances trust by establishing a transparent path that addresses organization-specific requirements. This consensus mechanism is crucial for harmonizing efforts and resources, ultimately contributing to cohesive and effective digital transformation (Essays 5, 6).

My results emphasize that effective digital transformation in healthcare requires not only a shared vision and collaborative efforts, but also substantial financial resources. To support this, public funding should be allocated in very targeted ways to achieve specific digitalization goals (Essay 5). Taking a public health and regulator's perspective on healthcare organizations, this dissertation further introduces MMs as **(5) federal-level funding instruments** that allow for the allocation of national funds at the federal level to support digitalization projects (Essay 5). Assessing organizations by means of MMs provides a structured approach to evaluate the completeness and detail of potentially relevant digitalization projects; such evaluation is crucial to accurately specify the funding needs for particular projects. The step width between maturity levels needs to be designed such that clear and detailed funding proposals align with the specific digitalization goals (Essay 5, 6). A significant example with broad reach is the PHAMM, which my co-authors and I developed as part of a Germany-wide application, with one purpose being the allocation of €800 million from the Federal Ministry of Health's €4 billion package for digitalizing PHAs. The MM in this scenario both provides concrete practices for digitalization and ensures the distribution of national funds so that PHAs have the necessary means to implement these practices (Essay 5).

6.2 Contributions to Theory

Existing research offers multiple avenues and perspectives to gain an understanding of medical professionals' behaviors regarding ISs, and established behavioral concepts and theories have guided this thesis. By analyzing the interactions between healthcare professionals and ISs through six essays, each study provides unique theoretical contributions, which are thoroughly discussed at length. This chapter synthesizes the theoretical contributions from the six essays and answers the three research goals.

To address **RG1**, **the impacts of contextual factors,** the findings confirm and expand on existing determinants of behaviors. The identified factors are great examples of facilitating conditions as described in the literature and within this dissertation, specifically contextualized in the healthcare context. Following their identification, they are then mapped onto existing behavioral theories to answer RG1: understanding contextual factors' impacts on behaviors. This dissertation highlights the significance of the monetary and regulatory frameworks, as well as the system market design, in shaping healthcare professionals' interactions with technologies. Further, regulatory frameworks ensure legal backing and data security, which are critical for healthcare professionals to trust and adopt new technologies (Essays 1, 2, 4). The system market design, characterized by vendor lock-in effects owing to high regulation, limits the entry of new competitors and emphasizes the need for robust, interoperable systems (Essay 4). At the organizational level, strategic management decisions and supportive administrative policies strongly affect the human factor (Essay 4). Properly designed processes and workflows that fit the planned IS landscape can reduce workaround behaviors and can ensure seamless integration (Essays 1, 4). This finding aligns with the emphasis on process design in the literature (Gopal et al. 2019) and underscores the importance of organizational readiness for digital transformation (Kruszyńska-Fischbach et al. 2021). An existing IT infrastructure must evolve to meet healthcare professionals' demands, and systems must be compatible with existing practices to facilitate adoption (Essay 1, 4). As highlighted in the DOI by Rogers (2003), compatibility is crucial for the acceptance of new technologies. Also, providing robust IT support and involving users in a system's design and its implementation is critical to reduce IT anxiety and increase interactions with ISs (Essays 1, 2, 3, 4). These factors resonate with the external variables identified in the TAM and the facilitating conditions described in UTAUT (Venkatesh et al. 2003). Social norms play a crucial role in shaping behaviors, aligning with the social norms construct in UTAUT (Venkatesh et al. 2003) and the adopter types in the DOI (Rogers 2003). The influences of media, professional associations, organizational management,

and role models on healthcare professionals' behaviors are significant (Essays 1, 2, 3, 4). Media representation and support from professional associations can educate and influence both healthcare professionals and the public about the benefits and challenges of digital transformation (Essays 1, 3). This confirms the relevance of external variables in the TAM (Davis 1985) and social norms in UTAUT (Venkatesh et al. 2003), highlighting social influences' impacts on technology adoption. In an organization, a panel of experts and managers can guide the alignment with organizational goals, and individual role models can live up to a standard, fostering acceptance and integration (Essays 3, 4). This aligns with a positive environment for technology adoption, the facilitating conditions in UTAUT (Venkatesh et al. 2003), and Rogers' (2003) emphasis on the role of opinion leaders and early adopters in spreading new technologies.

Regarding **RG2**, **the impacts of individual factors**, this dissertation confirms the clusters of established determinants (see Chapter 2.3) by highlighting the following: Regarding the judgment of efforts against resource and time constraints when practitioners are constrained by time and resources, they critically evaluate whether a new system will truly save time or streamline their workload, resonating with perceived usefulness from the TAM (Davis 1985). Practitioners will weigh a system's expected performance benefits and effort expectancies against their current constraints and how seamlessly compatible it is with infrastructure and how well it integrates into routines, as described in the DOI (Rogers 2003) and UTAUT (Venkatesh et al. 2003), rendering complex systems that further exacerbate their constraints unattractive. A system that can demonstrably improve efficiency under tight resource conditions will meet high performance expectancy, and an advantage must be evident in terms of saving time, reducing errors, and/or improving outcomes for patients (Keasberry et al. 2017). Under resource and time constraints, ease of use becomes critical, as a system should not add to a practitioner's burden (Dymek et al. 2021). In terms of the introduced minimum requirements threshold, theoretical models such as the TAM (Davis 1985), UTAUT (Venkatesh et al. 2003), and the DOI (Rogers 2003), along with their extensions, provide the foundation for the idea that healthcare practitioners will only consider new systems if they meet key criteria such as time-efficiency, diagnostic quality, and data security, which resonate with their determinants effort expectancy, performance expectancy, and perceived usefulness. Adding to these determinants, this dissertation introduces the strong claim that, if the minimum requirements are not met, users will not even contemplate using ISs (Essay 1). The professional ethos of healthcare practitioners is an individual belief that is deeply influenced by external

factors such as education, role models, habits, and experiences (Essays 1, 2, 3, 4). These influences are consistent with social influences, the facilitating conditions from UTAUT (Venkatesh et al. 2003), the external variables from the TAM (Davis 1985), and intrinsic motivation (Davis et al. 1992). In this regard, emphasizing medical professionals in their role as providers rather than as individuals, Meskó and Spiegel (2022) proposed a revised Hippocratic Oath for the digital era, to reflect the intrinsic use of technology, validate the equal-level patient role, and address data and data privacy in the daily practice of medicine. This dissertation adds to the substantial research stream on digital literacy and knowledge in healthcare, e.g., Dratva et al. (2019), Pfob et al. (2021), and Kuek and Hakkennes (2020), and confirms them as the strongest levers towards successful digital transformation (Essays 1, 2, 3, 4). The results show that enhancing digital literacy and knowledge among healthcare professionals reduces concerns and biases, shows value, and enables reflective decisions, fostering an overall digitally positive culture (Essays 1, 2, 3, 4). The results allow for a connection between digital literacy, digital knowledge, and IT anxiety (Essays 1, 2). The findings on IT anxiety support anxiety's negative effects on cognitive responses, such as the affective component of attitude (Bagozzi and Burnkrant 1979a) and expectancies, particularly process expectancy (Morris et al. 1981; Philipi et al. 1972). SCT proposes that anxiety impacts on expectancies, and vice versa. Thus, higher IT anxiety levels lead to higher expected effort levels (Bandura 1986).

For RG1 and RG2, this dissertation confirms and adapts existing determinants of behaviors to the healthcare context, providing new perspectives on how digital transformation can be successful. By addressing contextual, organizational, social, and individual factors, this research highlights the importance of a comprehensive approach to achieving digital maturity in healthcare. Ensuring that facilitating conditions are met and levering the influences of social norms, providers' professional ethos, digital literacy, and digital knowledge can significantly impact on the successful adoption and use of HISs.

RG3 is to establish operational mechanisms that healthcare organizations need to consider for successful digital transformation towards a target state. In terms of broadening the application scope, the research into MMs for digitalizing public health agencies and end-of-life care networks contributes to the understanding of digital transformation in a heterogeneous healthcare landscape that involves a diverse set of organizations (Essays 5, 6). These studies demonstrate that MMs can serve as vision-enabling tools and can facilitate democratic negotiations, underscoring the importance of stakeholder involvement and collaborative

development processes to ensure that such models are contextually relevant and actionable (Essays 5, 6). This research emphasizes that there is no universally applicable MM. Instead, while common elements may recur across contexts, each model must be built to the specific circumstances of its application. The building or adaptation of MMs to the unique needs of different organizational contexts, particularly in federated settings, highlights the necessity of distinguishing between inter-organizational and intra-organizational applications. While there are commonalities that often recur across different contexts, as the MM evolves with the scope of its application, it must fit the particular needs of each context, starting with the problem definition (Becker et al. 2009). For instance, my research shows that, in both PHAs and RPHNs, these models must be tailored to fit specific operational and regulatory environments, with a clear understanding that dimensions cannot be universally applied but must be context-specific, for instance with differences in capacities for action and directive authority (Essays 5, 6).

Regarding the development process, the findings build on Becker et al.'s (2009) widely recognized framework for assessing and guiding organizational maturity, but extend it by incorporating the need for negotiation and consensus-building in public settings. This includes collaborative problem definition and a democratic development process that reconciles diverse perspectives and ensures that an MM reflects a consensus among stakeholders. This relevance can also be met by linking research and practice, two sides of MM development that need to work together to ensure the right levels of abstraction and formalization as well as real-world challenging, clear guidance, and practical support (Burmann and Meister 2021). Development iterativeness (Becker et al. 2009) is also emphasized, with ongoing feedback from stakeholders being crucial for refining and adapting an MM over time. This dynamic approach ensures that MMs remain relevant in the face of rapid technological change, enabling them to guide strategic planning and the implementation of innovative healthcare solutions. In an evolving process, there cannot be a final version of any MM aimed at digitally transforming organizations, as the static definition of maturity states in times of disruptive change must be interrogated (Burmann and Meister 2021). For instance, the highest current level of achievable maturity may be cloud-based technologies now, but new technological trends and concepts will need to be integrated in the future. Becker et al.'s (2009) framework ensures that the MM can be continually transferred and evaluated, which is extended by using it for structured funding allocation, guiding public fund distribution to support digitalization projects. This application goes beyond assessments to include financial decision-making. The results also emphasize practical enablement activities and guiding transfer materials (e.g., workshops and materials), to

facilitate effective use. Hence, the claim by Burmann and Meister (2021, p. 107), who criticized checkable characteristics and necessary actions for stepping up levels, calling instead for a holistic, reflected, "stronger emphasis on the differentiation between measurable maturity level parameter and evolutionary actions to achieve the next stage." As such, an approach is appropriate for many digitalization endeavors in multi-organizational, interconnected systems (e.g., federal systems, network structures); I argue that these refinements and learnings can be transferred to differing MM development contexts that involve a diverse set of healthcare organizations.

6.3 Implications for Practice

By integrating human behaviors into transformational approaches, organizations can better navigate the complexities of their journey towards digital maturity, counteract potential failures, and enhance their chances of long-term success. To prepare them for this journey, the environmental, organizational, and individual factors need to be translated into practice. I offer implications for different stakeholders in the healthcare domain: policymakers and lawmakers, system vendors, healthcare associations, healthcare organizations, and medical professionals within healthcare organizations. I will now address these implications and will extend them to selected MM applications.

6.3.1 Policymakers and Lawmakers

Policymakers and lawmakers have the unique ability to create a more supportive environment in which healthcare organizations operate. A prominent field of action is **financial incentives** – aiming to alleviate environmental and organizational conditions as well as answering to resource and time constraints and the minimum requirements threshold (Essay 1, 4). My results strongly urge governmental institutions to create funding structures that enable initial investments, to bring healthcare organizations to a foundational level of operations. These incentives can take various forms, including grants, tax breaks, and subsidies, which help healthcare organizations to invest in the necessary infrastructure, technology, and personnel, as for instance evidenced with the Patient Protection and Affordable Care Act (*Obamacare*) (Jaqua and Jaqua 2019). While initial investments are critical, it is equally important to ensure healthcare organizations' ongoing sustainability. Effective reimbursement policies should consider the full scope of healthcare services, including those induced by technological advancements (van de Wetering et al. 2017). My results indicate that, when healthcare organizations receive consistent and adequate compensation for their services, these policies

help maintain financial stability and therefore offer better starting points for digital transformation. These financial streams must not solely stem from federal, state, or communal budget funds, which often carry operational deficits; insurance companies also need to be held accountable for these reimbursement structures, especially in dual-financing structures (where investment is covered by state-level funding and operational costs by insurances or payers) (Barros and Martinez-Giralt 2015; Stephani et al. 2019). For instance, introducing billing numbers or components that account for technology-related efforts ensures that healthcare organizations are fairly compensated for investments and the efforts of integrating ISs into their daily routines. In this regard, MMs prove to be useful funding instruments that allow for the allocation of national funds at the federal level to support digitalization projects (Essay 5). Beyond this, this work adds practical transferability, as MMs can be subject to a broader type of generalization. For instance, the public health sector's attributes (decentralized, federalized, different resource availabilities, and low knowledge of digitalization) are also valid for other parts of the public sector, for instance, citizen services, universities, schools, and employment services (Olphert and Damodaran 2007).

Besides financial incentives, my results call on policymakers and lawmakers to create **market structures** that foster innovation and competition in the healthcare system vendor market, thereby altering the environmental conditions (Essay 4). Creating a competitive market environment requires that one incentivize both existing and new vendors to innovate. Besides increasing systems' adherence to regulations, innovation should also improve software's usability, ensuring that healthcare technology is both advanced and user-friendly, aligning with the best practices observed in the private sector. Policies that reward innovation and penalize stagnation (e.g., grants or tax incentives for companies that develop new technologies or improve existing systems) can stimulate market dynamics (Hall 2020).

As technological advancements continue to transform the healthcare sector, my results indicate that **data security and privacy protection** remain critical, which addresses the environmental conditions, answers to IT anxiety, and providers' professional work ethos. Governments have a vital role in enforcing standards and regulations that safeguard organizational and patient information that reflect current technological trends, such as the European Union's General Data Protection Regulation (GDPR) (Tzanou 2021). My results confirm the need for robust legislation that includes requirements for encryption, access controls, and regular security assessments, ensuring that healthcare organizations implement high data protection standards,

which need reiteration and adaptation so as to keep practices current and relevant. Further, governmental bodies or, on their behalf, impartial institutions, should establish standardized audit protocols and should perform routine inspections to verify compliance and identify vulnerabilities (Tzanou 2021). In this regard, MMs can provide support as assessment tools by providing structured frameworks for assessing, improving, or penalizing the capabilities of healthcare organizations and vendors. Organizations could publicly report their maturity levels, demonstrating their commitment to high standards. As practitioners and patients are engaged and informed about data security efforts and see that healthcare organizations are regularly inspected and comply with stringent regulations, their trust in the system is reinforced (Sharma et al. 2023). By offering training programs, developing compliance toolkits, and establishing technical assistance support centres, they can help healthcare organizations and vendors to achieve compliance.

As healthcare technology evolves towards black box IS usage, the issue of **liability regulations** for errors arising from new systems (especially AI-based) becomes increasingly critical and answers to environmental conditions, IT anxiety, and providers' professional work ethos. Governments must address the uncertainty of liability to ensure accountability and protect both vendors and practitioners, as it is crucial to clearly define who is accountable for system errors vs. human errors (Smith and Fotheringham 2020). For instance, my results indicate that vendors should be responsible for system errors resulting from software malfunctions or design flaws, while practitioners should be held accountable for errors relating to the misuse or misinterpretation of the system, and protocols for reporting and resolving incidents as well as clear guidelines for resolving issues and implementing corrective actions are needed.

6.3.2 System Vendors

System vendors have a key role in the successful integration and utilization of technologies in healthcare settings. To meet healthcare professionals' evolving needs, my results state that vendors are called on to **design systems** that are easy to use, time-efficient, and reliable, thereby answering to the environmental and organizational conditions, the minimum requirements threshold, and physicians' professional work ethos. Systems that are intuitive and user-friendly minimize disruptions to their workflow and allow them to focus on patient care; conversely, poorly designed systems exacerbate resource and time constraints (Eikey et al. 2019). Currently, digital transformation often falls short because users do not perceive the benefits of poorly designed IT systems. When ISs are designed in user-centered and reflective ways, my

results show how healthcare professionals can focus more on patient care (rather than struggling with, for instance, complex interfaces), which enhances their productivity and satisfaction, and answers to physicians' professional work ethos. Regarding how this translates into features, system vendors should consider contextuality and the need for flexible adaptations.

Also, these systems must enable practitioners to **work in autonomous ways**, which can translate into recommendations-based outputs of diagnosis systems (Funer and Wiesing 2024), customizability of workflows to tailor a technology to practices and routines (Costa de Araujo et al. 2016), or mobile system access to perform tasks from any location (Shaw et al. 2020). Systems that are designed to respect professional autonomy and allow for flexibility to adapt to different contexts empower healthcare professionals, who feel more in control of their work environment.

To ensure that these needs are met, my results confirm that it is crucial for system vendors to **engage medical professionals** early on, allowing them to participate in the design process. Accurate requirements-gathering involves direct inputs from the healthcare professionals who will be using the system, for instance by following design methodologies that factor in human factors and experiences (Harte et al. 2017). Such involvement ensures that healthcare professionals' real-world challenges, needs, and preferences are understood and incorporated into a system's design, which answers to physicians' professional work ethos. By involving practitioners in prototype testing and refining system features based on their inputs, vendors can develop more effective and user-friendly systems that support professional autonomy. This collaborative approach not only results in more practical and relevant technology, but also fosters ownership and trust among users (Akello and Nabukenya 2024). My results show that when practitioners see their feedback being incorporated into a final product, they are more likely to embrace and fully utilize a technology. This positive attitude towards a system increases their engagement and commitment to ongoing improvement and innovation in their practices.

6.3.3 Healthcare Associations

Healthcare associations have a pivotal role in defining the professional ethos of the healthcare sector. Their social influence extends beyond policy advocacy, reaching the core of professional work ethos, role identity, and practice. By taking an active role in building digital literacy and knowledge, particularly regarding emerging technologies, my results emphasize these associations' strong impacts on the profession's evolution and how they alter social norms,

while also answering to digital literacy and knowledge, IT anxiety, and providers' professional work ethos, as I will now describe. Their contributions to the public image, media, and journals help demystify ISs and highlight their benefits, which positively influence **digital perceptions** and user attitudes. When medical professionals encounter digital transformation success stories and understand ISs' practical advantages, they are more likely to embrace these technologies with curiosity and openness (Rogers 2003). This positive attitude can lead to increased experimentation, innovation, and a willingness to adopt new tools that can enhance patient care. In this regard, associations can lead public discourse and address common concerns, thereby building a sense of professional backing among practitioners and patients (Shaw 2014).

My results suggest how associations can use their reach by organizing regular **community meetings** in which practitioners, researchers, and technology developers come together to discuss challenges, share experiences, and explore innovative solutions. Such peer support networks enhance learning and provide practical insights into effective system use, making it easier for individuals to navigate and troubleshoot new technologies.

Further, my results delineate how healthcare associations can establish **a central panel of experts** who can evaluate new technologies, assess their potential impacts, and provide guidance on best practices. By disseminating their findings and recommendations, such a panel can help healthcare professionals to stay ahead of technological advancements, ensuring that they are prepared to adopt and effectively integrate new tools. Access to expert evaluations and best practice recommendations help medical professionals to take informed decisions about adopting and integrating ISs into their practices.

To extend their reach and influence, healthcare associations can – as my results show – **educate specific trainers**, for instance individuals who can disseminate knowledge and best practices within their own organizations or networks. By training these multipliers as ambassadors, associations can ensure that key messages and insights reach a broader audience. These ambassadors can then facilitate workshops, seminars, and training sessions in their own institutions, promoting the adoption of ISs and practices. This approach not only enhances digital literacy but also builds self-efficacy, in the desire to make a difference and spread enthusiasm among healthcare professionals.

6.3.4 Healthcare Organizations

Healthcare organizations and their managers have a crucial role in facilitating the effective use of ISs by medical professionals by altering the organizational conditions, the resource and time constraints, and the minimum requirements threshold. It is the organization's responsibility to create an **organizational work system** that allows for efficient working (Kruszyńska-Fischbach et al. 2021), addressing any infrastructural challenges that may hinder the seamless use of ISs, which answers to resource and time constraints. While they bear these responsibilities, healthcare organizations are also backed into a corner, as they have limited financial and personnel resources while still needing to maintain standards. I identify how, while they themselves are limited by regulatory and financial boundaries, there are many paths to building organizational capabilities, such as designing processes that match user requirements. Importantly, regarding deciding on new ISs and their implementation, I argue that organizations need to consider the individual end-user factors, most importantly their professional ethos and minimum requirements (time-efficiency, diagnostic quality), and must consider the impacts on possible adoption. Bringing to light details on challenges and needs and translating them into actionable practices can reduce frustrations and inefficiencies. This support enables medical professionals to focus on their core tasks without being held back. As a result, they are more likely to adopt and effectively use ISs, leading to a more streamlined and efficient workflow (Cresswell et al. 2013). As demonstrated, healthcare organizations can achieve a state of readiness and continual improvement by utilizing MMs, assessing their current state, and outlining a vision for the future. Such systematic progression offers a holistic picture of digital transformation with interdependencies and fosters a culture of continual improvement. When using a bottom-up approach, as professionals contribute to a consensual vision and see tangible progress and benefits from their efforts, their engagement and commitment to reaching the next maturity level are likely to increase.

Individuals are unlikely to adopt ISs solely based on intrinsic motivation, highlighting the need for organizations to implement strong **incentives** to encourage the use of these technologies, which answers to physicians' professional work ethos. This need for incentivization is particularly critical in contexts where IS adoption is voluntary, as practitioners may not see immediate personal benefits in utilizing a system. Even in scenarios in which IS use is mandated, organizations must still provide sufficient motivation and support to ensure that practitioners engage with a technology as, otherwise, workarounds or non-use likely occur.

Such incentives could range from financial rewards (e.g., digital skill or project incentives in work contracts) to professional development opportunities. It is crucial to engage individuals with substantial digital transformation experience, and tasks should not be assigned to those who manage it as a side responsibility or who lack training. Whether internal or external, professionals must be dedicated and equipped to handle the complexities involved.

If financial resources to attract these talents are limited, one of the most impactful actions healthcare organizations can take is to provide **comprehensive user training and support**, which answers to literacy, knowledge, IT anxiety, and physicians' professional work ethos. My results highlight hands-on training, including demonstrations, interactive workshops, and practical implementation guidelines. These initiatives help medical professionals to become familiar with new technologies, enhancing their confidence in using a system (McAlearney et al. 2012). With comprehensive training and support, medical professionals are less likely to feel overwhelmed by new systems, reducing IT anxiety and improving emotional wellbeing. This increased confidence leads to a more proactive and positive attitude towards learning and utilizing IT tools, ultimately enhancing their efficiency and effectiveness in patient care. For instance, the introduction of digital pilots (i.e., individuals trained to guide their colleagues through digital transitions) can further ease the adoption process. Also, train-the-trainer concepts can be used, enabling quicker and broader dissemination of information and guidance within daily routines. A panel of external or internal experts can provide ongoing support, contributing to a more integrated and effective use of technology.

My results highlight how creating a **digitally open culture** and psychological safety in an organization encourages the adoption and effective use of IT systems, further shaping physicians' professional work ethos. Managers must actively promote a positive attitude towards digital change and must emphasize the benefits of new technologies. This involves clear communication about the advantages and risks of ISs, providing success stories, and transparently delivering to operational challenges (Gardner et al. 2023; Krasuska et al. 2020; Wu et al. 2010). This cultural shift fosters curiosity and a willingness to experiment with new tools, leading to lower resistance and more effective uses of ISs in daily practice.

6.3.5 Medical Professionals

Digital transformation in healthcare hinges not only on the infrastructure and support provided by healthcare organizations, but also on active participation by medical professionals. As discussed, they are subject to contextual and organizational influences, such as significant resource and time constraints and low exposure to satisfactory ISs. On this time-intensive foundation, practitioners are not expected to independently build digital literacy and knowledge; instead, the focus is on encouraging reflection and openness to active participation. **Awareness of biases** is crucial for medical professionals as they interact with digital systems. Recognizing and addressing biases ensures that these professionals approach digital tools with an open mind, enhancing their ability to effectively lever these technologies without overconfidence in their judgments and actions (Oschinsky et al. 2020).

I call on medical professionals to base their decisions on evidence and data, **levering bidirectional insights** (on both benefits and risks) regarding ISs for their specific application domain and scenario, and to interrogate their opinions when faced with transformation projects. This ensures that a new initiative is not assessed based on a bias owing to a failed previous initiative, and helps raise their literacy and knowledge while reducing potential IT anxiety.

Further, my results confirm that, by acting as **role models and educators**, professionals can elevate their peers' digital competence and can live out their professional ethos by supporting colleagues, shaping social norms. In this regard, peer training and mentorship can significantly reduce the learning curve for new users, leading to swifter adoption and more efficient use of digital systems. I identify that, when best practices are widely shared and adopted, it leads to standardized procedures that enhance consistency and reliability in daily operations. Likewise, by discussing experiences and habits, teams can quickly address issues, leading to smoother daily operations. Immediate technical assistance reduces downtime and frustration, enabling colleagues to resolve issues swiftly and continue their work without significant interruptions. Considering the resource and time constraints, a positive attitude towards change can be contagious. When colleagues see the benefits of new technologies and observe positive attitudes among their peers, they are more likely to embrace these changes themselves (Rogers 2003). To summarize and give an overview, Table 7 delineates the key practical implications per actor.

Table 7: Practical Implications of this Cumulative Dissertation

Actors	Calls to action	Contributions to contextual and/or individual factors
Policymakers and lawmakers	• Provide financial incentives • Set vendor market structures for innovation and competition • Ensure and communicate data security and privacy protection • Specify the liabilities of system vendors and medical professionals	• Altering of environmental and organizational conditions • Answering to resource and time constraints, the minimum requirements threshold, and providers' professional work ethos
System vendors	• Design systems that are easy to use, time-efficient, and reliable • Respect autonomous ways of working • Engage medical professionals	• Altering of environmental and organizational conditions • Answering to providers' professional work ethos
Healthcare associations	• Shape public image, media, and journals • Organize community meetings • Establish a central panel of experts • Educate multipliers	• Altering of social norms • Answering to digital literacy, digital knowledge, IT anxiety, and providers' professional work ethos
Healthcare organizations	• Sustain the organizational work system • Provide incentives for voluntary and mandatory use of ISs • Integrate human behaviors into the IS selection and implementation process • Provide user training and support • Foster a digitally open culture	• Altering of organizational conditions • Answering to the resource and time constraints, the minimum requirements threshold, digital literacy, digital knowledge, IT anxiety, and providers' professional work ethos
Medical professionals	• Reflect evidence-based information on the benefits and risks of ISs • Challenge individual biases • Serve as role models and support colleagues	• Altering of social norms • Answering to digital literacy, digital knowledge, IT anxiety, and providers' professional work ethos

In summary, the actions of each actor in the digital transformation of healthcare are deeply interconnected, significantly influencing the behaviors of medical providers in using IS. Policymakers and lawmakers set the stage with supportive regulations and incentives, which boost medical professionals' confidence and willingness to adopt new technologies. Guided by these regulations and direct feedback from practitioners, system vendors are asked to develop user-friendly and practical tools that enhance professionals' efficiency and satisfaction. Therein, healthcare associations have a crucial role in fostering a positive perception and understanding of digital tools, framing the professional ethos, and encouraging medical professionals to engage, learn, and innovate. Healthcare organizations need to facilitate this by providing the necessary training, support, and infrastructure, by reducing IT anxiety, and by promoting a proactive attitude towards technology. Together, these efforts create an environment where medical professionals are more likely to reflect, embrace, utilize, and benefit from digital transformation, ultimately influencing peers and levering the path to maturity and improved patient care.

7 Limitations and Future Research

The results of this dissertation are subject to the methodologies, study contexts, and theoretical frameworks employed in the individual essays, which are comprehensively analyzed in each research paper. These limitations affect the findings' generalizability, yet they also depict starting points for further research. I will now summarize the overarching constraints and will outline future research avenues.

The first primary limitation involves the potential for different outcomes depending on the **data and research contexts**, impacting on the results' generalizability. While the analyzed settings provide valuable insights into healthcare professionals and organizations, they may not fully represent all the diverse scenarios and stakeholders involved in digital transformation. Differences in organizational characteristics such as size, type, resource availability, cultural differences, geographic location, regulatory environment, patient demographics, or inter-organizational relationships could yield varying results. Thus, care is advised when applying these findings to other healthcare contexts. Future research should explore various settings to validate and refine these insights, enhancing their external validity. Also, the studies focus on healthcare practitioners yet exclude patients, who are the recipients of care and impact on decision-making, even more so in their new role as empowered participants. Future research could mirror this approach, focusing on patients instead. As the incorporated studies were based in Germany, with enrichment from Australia (Essay 3) and the U.S. (Essay 4), broader validity requires cross-country analyses to understand the distinct impacts of varying regulatory and organizational characteristics.

These research design and methodological limitations open exciting thematic avenues for future research, which I will now detail. The second limitation is the inconclusive **link between digital maturity and healthcare outcomes**. Following Woods et al. (2023a), although digital maturity is generally linked to improved implementation of technologies, its direct effects on outcomes such as patient experience, clinician satisfaction, population health, and cost-efficiency have largely remained unexplored. To justify the significant investments in digital transformation, it is crucial to establish definitive evidence that connects digital maturity to these key quality measures (Woods et al. 2023b) and, following Essay 6, to integrate the concept of digital readiness. Similarly, quantitative assessments are needed following my proposition that behavior impacts on (digital) maturity, also in contrast to potentially relieving digital transformation failures. It is reported that well-managed and digitally mature organizations

typically have comprehensive policies and procedures that minimize harmful events and ensure safe care (Martin et al. 2019). Thus, future research should delve into the relationships between digital transformation, digital maturity, and care outcomes, the effectiveness of quality improvement initiatives, and overall health IT development. While the potentials of health IT to enhance care quality have been recognized, a deeper understanding of their impacts on de facto care delivery in diverse, real-world settings is necessary to maximize their benefits.

A third limitation is the consideration of **interdependencies and the strengths of the impacts of various factors** that influence digital transformation and behaviors. Different clusters of factors have varying impacts, and it is crucial to identify the most promising ones, especially given the implications across different levels. For instance, the relationships between organizational conditions and organizations' financial capabilities need further exploration. Even though investment jams are one key reason for, e.g., Germany's digitalization backlog (Stephani et al. 2019), financial constraints should not be used as an excuse for organizational actors to overlook other critical issues and mainly trace all issues back to environmental conditions. Future research should quantitatively investigate the dependencies among these factors. Also, the costs and quality outcomes of health IT investments are still not fully understood, and the returns on investment from expensive IT projects may take years to materialize and can be hard to verify, which is a further research opportunity (Woods et al. 2023b).

A fourth limitation is the need to understand how contextual and individual factors influence **different user types**, as outlined by the DOI (Rogers 2003). While the current research generalizes findings based on a broad population, in reality, users have diverse characteristics, such as varying levels of digital literacy, knowledge, and trust (Chen et al. 2018). It would be valuable to identify which contextual and individual factors have the greatest impacts on specific adopter types. Understanding these nuances could help tailor digital transformation efforts to individual behaviors, enabling leaders and digital change agents to implement more targeted and effective strategies.

Similarly, as a fifth limitation, **technology characteristics** significantly influence behaviors, but fall outside this dissertation's scope. Researchers should explore how the foundational aspects and specific features of digital health systems – such as system interfaces, functional transparency, and adaptability – impact on the behavioral determinants and actions of healthcare professionals. Going forward, Schuetz and Venkatesh (2020) suggest that emerging

technologies and cognitive computing systems disrupt traditional IS assumptions of systems being simply tools with consistent functionality in an input-throughput-output stream. These traditional assumptions shape our understanding of human-IT interactions. However, cognitive computing systems possess more human-like capabilities, making interactions resemble human-to-human communication and challenging current behavioral theories. This evolution necessitates new research paradigms to better understand and optimize interactions between humans and advanced technologies to foster trust and acceptance in health-related application scenarios.

8 Conclusion

Digital transformation in healthcare seeks to enhance service quality, improve workflow efficiency, and reduce costs, fundamentally changing operations to increase value to patients (Williams et al. 2019). Medical professionals who deliver the primary service value require full support from ISs to perform effectively and efficiently (Flanagan et al. 2013). While technology is often viewed as the driver of digital transformation and maturity, human and organizational factors are usually more critical (Carroll et al. 2023; Kane 2019; Wessel et al. 2021). High failure rates of digital transformation initiatives highlight the need for a deeper understanding of the underlying causes, emphasizing human behaviors' key roles in ensuring long-term success (Duncan et al. 2022; Granja et al. 2018).

This cumulative dissertation explores the complexities of digital transformation in healthcare organizations, focusing on the interplays between contextual, organizational, and individual factors that shape healthcare professionals' interactions with ISs. It encompasses six essays composed of seven articles, addressing three primary research goals.

First, it seeks to understand how contextual factors – such as environmental conditions, organizational elements, and social norms – shape the interactions between healthcare professionals and ISs. These factors must be tailored to specific healthcare settings to ensure relevance and effectiveness.

Second, it analyzes individual characteristics that influence IS acceptance and behaviors, identifying key determinants that are role-specific to medical professionals, such as judging against a resource and time constraint and a minimum requirements threshold, practitioners' professional ethos, digital literacy and knowledge, and IT anxiety.

Third, it identifies operationalization mechanisms to facilitate digital transformation using MMs. The development and application of these models provide a structured framework for assessing the status quo, identifying areas for improvement, and systematically planning progressive enhancements. Therein, it is important to consider the specifics of the medical sector in a MM's application scope, the possibility of using it for joint consensus and federal funding, and organizations' differences in capacity for action and directive authority.

In summary, policymakers and lawmakers, system vendors, healthcare associations, healthcare organizations, and medical professionals are all called on to contribute their individual efforts to reflect on human behaviors for the successful, step-wise digital transformation and enhanced digital maturity of healthcare organizations. Moving forward, the ongoing integration of ISs

into healthcare will undoubtedly face further challenges, but the potential benefits, improved patient outcomes, greater accessibility, and enhanced efficiency make it a journey well worth undertaking, and doing so properly, so as to avoid both known hurdles and digitalization project failure.

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10 Appendices

Appendix A: Research Articles and Indices

This overview details the six essays (seven articles) included in this dissertation, their publication statuses, and the author team, with a classification of the contributions as either equal, lead, or subordinate. In sum, I have contributed equally four times; of this twice as a co-lead on equal teams, followed by a single lead and a single subordinate authorship.

Essay (#) and title	**Publication outlet and status**	**Author team and own contribution**
(1) *General Practitioners' Attitudes Toward Artificial Intelligence-Enabled Systems: Interview Study*	*Journal of Medical Internet Research* VHB-JQ3 B Equivalent/ VHB 2024 B *(published)*	Christoph Buck, Eileen Doctor, Jasmin Hennrich, Jan Jöhnk, and Torsten Eymann (*co-lead author, equal contribution*)
(2) *Examining Supporting and Constraining Factors of Physicians' Acceptance of Telemedical Online Consultations: A Survey Study*	*BMC Health Services Research* VHB-JQ3 C/ VHB 2024 C *(published)*	Sören Diel, Eileen Doctor, Riccardo Reith, Christoph Buck, and Torsten Eymann (*co-lead author, equal contribution*)
(3) *Enabling Physicians to Make a Sensible Adoption-Decision on Artificial Intelligence Applications in Medical Imaging Diagnosis*	*Journal of Medical Internet Research* VHB-JQ3 B Equivalent/ VHB 2024 B *(accepted)*	Jasmin Hennrich, Eileen Doctor, Reeva Lederman, Marc-Fabian Körner, and Torsten Eymann (*subordinate authorship*)
(4a) *A Systematic Literature Review on Antecedents of Workarounds Related to Information Systems in Hospitals*	*15th International Conference on Wirtschaftsinformatik* VHB-JQ3 C/ VHB 2024 B *(published)*	Christoph Buck, Eileen Doctor, Torsten Eymann, and Eduardo J. Simoes (*equal contribution*)
(4b) *Antecedents of Workarounds Related to Hospital Information Systems: Interview Study*	*Journal of Medical Internet Research* VHB-JQ3 B Equivalent/ VHB 2024 B *(accepted)*	Eileen Doctor, Jasmin Hennrich, Torsten Eymann, and Christoph Buck (*co-lead author, equal contribution*)
(5) *A Maturity Model for Assessing the Digitalization of Public Health Agencies: Development and Evaluation*	*Business & Information Systems Engineering*	Eileen Doctor, Torsten Eymann, Daniel Fürstenau, Martin Gersch, Kristina Hall, Anna Lina Kauffmann (Wolf), Matthias

	VHB-JQ3 B/ VHB 2024 B *(published)*	Schulte-Althoff, Hannes Schlieter, Jeannette Stark, and Katrin Wyrtki (Körner) (*equal contribution*)
(6) *Reconsidering the Promise of Digital Transformation – Navigating Maturity in Heterogeneous End-Of-Life Care Networks*	*32nd European Conference on Information Systems* VHB-JQ3 B/ VHB 2024 A *(published)*	Eileen Doctor, Jasmin Hennrich, Sven Schwabe, Hanna Röwer, Torsten Eymann, and Christoph Buck (*lead contribution*)

Appendix B: Declarations of Authorship and Individual Contributions

The essays presented in this dissertation stem from joint developments, involving cherished colleagues from various backgrounds to ensure a multidisciplinary approach. I will now report my contributions, following the Contributor Roles Taxonomy (CRediT)[2] author statement.

Essay (#) and title	**Own contribution (following the CRediT author statement)**
(1) *General Practitioners' Attitudes Toward Artificial Intelligence-Enabled Systems: Interview Study*	Conceptualization (co-lead), investigation, validation, writing – original draft, writing – review and editing, and visualization.
(2) *Examining Supporting and Constraining Factors of Physicians' Acceptance of Telemedical Online Consultations: A Survey Study*	Conceptualization (co-lead), methodology, writing – original draft, writing – review and editing, visualization, and project administration.
(3) *Enabling Physicians to Make a Sensible Adoption-Decision on Artificial Intelligence Applications in Medical Imaging Diagnosis*	Validation, writing – original draft, writing – review and editing, and visualization.
(4a) A Systematic Literature Review on Antecedents of Workarounds Related to Information Systems in Hospitals	Conceptualization, methodology, formal analysis, investigation, writing – original draft, writing – review and editing, visualization, and project administration.
(4b) *Antecedents of Workarounds Related to Hospital Information Systems: Interview Study*	Conceptualization (co-lead), methodology, formal analysis, investigation, writing – original draft, writing – review and editing, visualization, and project administration.
(5) *A Maturity Model for Assessing the Digitalization of Public Health Agencies: Development and Evaluation*	Conceptualization, investigation, writing – original draft, writing – review and editing, and visualization.
(6) *Reconsidering the Promise of Digital Transformation – Navigating Maturity in Heterogeneous End-Of-Life Care Networks*	Conceptualization (lead), methodology, formal analysis, investigation, writing – original draft, writing – review and editing, visualization, and project administration.

[2] Allen, Liz, et al. (2014). Publishing: Credit where credit is due. *Nature 508*(7496): 312-313.

Appendix C: Other Publications and Working Papers

During my time as a research assistant, I co-authored research articles that are not part of this dissertation. They are:

Reference	Ranking and status
Ehaus, M., **Doctor, E.,** Eymann, T., Körner, M-F. Why should I trust you, Watson? Structuring Trust in Cognitive Computing Systems.	Working paper
Röwer, H., Buck, C., **Doctor, E**., Herbst, F.A., Schleef, T., Schneider, N., Schwabe, S. (2023). HOPAN – Ein Projekt zur Bestandserhebung und Analyse regionaler Hospiz- und Palliativnetzwerke mittels eines adaptierten Instruments zur Qualitätsbeurteilung (2023). Bundes-Hospiz-Anzeiger 21: 16-17.	n/a, research transfer article (*published*)
Schwabe, S., Buck, C., **Doctor, E**., Herbst, F.A., Röwer, H., Schleef, T., Stiehl, S., Schneider, N. (2023). Bestandserhebung und Analyse regionaler Hospiz- und Palliativnetzwerke in Deutschland mithilfe eines Reifgrad-modells. Protokoll einer gemischt-methodischen Studie [Poster und Abstract]. Deutscher Kongress für Versorgungsforschung, Berlin, 34.	n/a, research transfer article (*published*)
Schwabe, S., Röwer, H., Kamandi, N., **Doctor, E**., Buck, C., Schneider, N (2023). Identification of regional hospice and palliative care networks in Germany – Results of a multi-method survey. Zeitschrift für Evidenz, Fortbildung und Qualität im Gesundheitswesen (ZEFQ) 182-183: 79-88.	n/a (*published*)
Doctor, E., Buck, C., Eymann, T. (2020). Digitale Transformation in Krankenhäusern: Potenziale und Innovationen entlang des stationären Leistungsprozesses. In: Pfannstiel, M., Kassel, K., Rasche, C. (eds) Innovationen und Innovationsmanagement im Gesundheitswesen. Springer Gabler, Wiesbaden. https://doi.org/10.1007/978-3-658-28643-9_15	n/a, research transfer article (*published*)
Buck, C., **Doctor, E.,** Eymann, T. (2020). Vermeidung der medizinischen Unterversorgung ländlicher Strukturen durch innovative Ansätze der Telemedizin. In: Pfannstiel, M., Kassel, K., Rasche, C. (eds) Innovationen und Innovationsmanagement im Gesundheitswesen. Springer Gabler, Wiesbaden. https://doi.org/10.1007/978-3-658-28643-9_38	n/a, research transfer article (*published*)
Doctor, E., Buck, C., Keweloh, C., Eymann, T. (2019). Towards a Taxonomy of Digital Twin Applications for	VHB-JQ3 B/ VHB 2024 A Research in progress

Telemedicine. Proceedings of the 29th European Conference on Information Systems (ECIS). Association for Information Systems, 2019.	(*published*)
Hufnagl, C., **Doctor, E.,** Behrens, L., Buck, C., Eymann, T. (2019). Digitisation along the patient pathway in hospitals. Proceedings of the 27th European Conference on Information Systems (ECIS). Association for Information Systems, 2019.	VHB-JQ3 B/ VHB 2024 A (*published*)