TECHNOLOGY IN HEALTHCARE

A Techno-Anthropological study investigating factors influencing implementation in hospitals

AALBORG UNIVERSITY

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Master thesis

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Study program: MSc Techno-Anthropology, Aalborg University, Copenhagen

Semester: TAN10, ECTS: 30

Number of keystrokes: 156.180, equal 65 standard pages

Number of Appendices: 3

Hand in date: 07-06-2024

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Abstract

The Danish healthcare system is facing significant challenges including workforce shortages and demographic changes. Political initiatives emphasize the role of digital technologies as a solution to address these issues by promoting technology that is labor-saving. This study aims to investigate the facilitators and barriers to effective technology integration in hospitals and its role in overcoming the healthcare challenges. The empirical data was conducted through semi-structured interviews with health stakeholders from Research and Innovation of Rigshospitalet, The Danish health technology council, Center for IT and Medical Technology and Copenhagen Health Innovation. Ethnographic fieldwork was conducted at the Neurological Ward at Nordsjællands Hospital, investigating the healthcare professionals newly implemented monitoring system, Teoton.ai. Furthermore, a survey of healthcare professionals view on technology implementation in healthcare was conducted. The Technology Acceptance Model 2, Self-Efficacy, and Digital Health Literacy was chosen as the theoretical lens for this study to add a socio-technical perspective on the empirical data. The Technology Acceptance Model 2 provides insights into perceived usefulness and ease of use, while Self-Efficacy focuses on individuals' confidence in using new technologies. Digital Health Literacy emphasizes how the level of technological skills affect usability.

The findings revealed that technological skills among healthcare professionals and the work environment affect the implementation of new technologies. This study concludes that enhancing digital literacy among healthcare professional might be essential to unlock the potential of technology implementation in hospitals. The potential outcome of this is to improve technology implementation in hospitals and in the end enhance patientcare. Together with political initiatives to improve the work environment this can potentially be a step towards overcoming the Danish healthcare challenges. Additionally, further research is needed to investigate the role of digital literacy in technology implementation in hospitals and to explore ways to improve digital literacy to find specific socially responsible solutions.

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Introduction

This study investigates the factors influencing the implementation of technology in healthcare from a Techno-Anthropological perspective. The integration of technology in healthcare is a nuanced process that holds the potential to support in overcoming challenges in the Danish healthcare system and potentially improve patient care. Recognizing the interaction between technology and clinical practices is essential to unlock this potential. With this socio-technical approach both human and technical factors in the adoption process is to be investigated. The focus is more specifically on hospital environments, directly connected to my personal experiences in the field.

The motivation for this research is deeply rooted in personal experiences I have gained from my background as a nurse. While working as a nurse at the Department of Urology at Rigshospitalet, I experienced the introduction of various technological solutions including the electronic health record, known as "Sundhedsplatformen" (The E-health Platform). This system introduced a new way of documenting patient information, including the handheld device looking like a smartphone called a Rover which completely changed the culture of documentation. Before the implementation of Rovers, vital signs measured in the patient room such as blood pressure and temperature, were written down on paper and later documented on a computer in the nursing office. With Rovers it became possible to document this patient information while standing next to the patient making this process more effective as it reduced duplicative work and ensured the documentation was more time accurate. However, this was not always the case as the introduction of the E-health platform required a significant change in work culture and it took time to adopt these new routines and integrate the technology into daily work practices. These technologies aimed to optimize the work of healthcare professionals and thereby eventually benefit patients. While some technology implementations achieved these goals, others led to frustration due to lack of involvement or unexpected issues during the implementation process. On firsthand I saw the potential benefits and challenges of new technologies in a healthcare setting. Successful implementations facilitated our work and improved patient care, contrary unsuccessful ones created frustrations among me and my colleagues. This duality motivated my interest in understanding why some technologies succeed while others fail seeing a potential for improvement. This experience inspired me to pursue a master degree in Techno-Anthropology culminating in this thesis, which investigates the factors influencing the development and implementation of technological solutions in hospitals.

The implementation of technology in hospitals is a nuanced process influenced by various factors. For instance, The Danish healthcare system is facing workforce shortage, predicted to worsen with demographic shifts and increasing demands for healthcare services (KL, 2022). Additionally, high work pressure and poor work environments have led to a 50% rise in resignations among healthcare professionals in the past four years (Sundhedsmonitor, 2024a). Political initiatives emphasize the role of technology in addressing these challenges promoting digital solutions and welfare technologies as tools to enhance efficiency and quality of care (Indenrigs- og Sundhedsministeriet, 2023a). However, successful technology implementation requires overcoming significant barriers, including organizational readiness, staff training, and clear workflow integration (Danske Regioner, 2022).

Hereby healthcare is increasingly reliant on technological innovations to improve patient outcomes, improve workflows, and enhance the efficiency in healthcare. Conversely, the implementation of these technologies can rise challenges. These challenges can arise not only from the technical aspects of the technologies but also from the human and organizational integration that influence the adoption and use of technology in healthcare. A deeper understanding of these factors is essential for ensuring that technological solutions are both effective and social sustainable when integrated into healthcare professionals work environment.

In the next section, the current state of technological integration in the Danish healthcare system will presented through a problem analysis. Hence the demographic trends, workforce prognoses, and specific challenges faced by healthcare professionals. The political initiatives and recommendations aiming to address these challenges, with a particular focus on the role of technology in improving workforce shortages and patient care will be unfolded. Providing a understanding of the landscape on some of the factors influencing technology adoption in healthcare.

Problem analysis

This section can be seen as a funnel, narrowing down from broad problems in the health care system to the more specific research questions. The nuances of the problem is described by addressing the challenges in the Danish healthcare system. These challenges include a decrease in workforce and an aging population, leading to a rise in citizens with chronic diseases. Furthermore, the information revolution, the aspects of the integration of technology in healthcare and growing expectations of modern healthcare consumers are addressed as some of the challenges. The increasing work shortage among healthcare professionals due to a pressured work environment resulting in resignations is exacerbating the issue. These challenges have created a need for initiatives to improve the healthcare sector and politically, one of the initiatives to overcome some of these challenges is through the integration of technology in healthcare. The challenges in technology implementation in healthcare are addressed in the following sections, underlining the barriers of integrating technology in healthcare.

The Danish healthcare challenges

The article *"Five megatrends challenging the future healthcare"*, addresses the significant trends expected to challenge and herby influence the Danish healthcare system. These five megatrends are: *"1. The aging population, 2. The increasing prevalence of chronic diseases, 3. The information revolution, 4. The blessing and curse of clinical technology and 5. The new healthcare consumer"* (Højgaard & Kjellberg, 2017, p.6). The framework for this problem analysis is inspired by the framework of these five megatrends, to outline different aspects of the challenges in the Danish healthcare system.

1. The aging population

The Danish healthcare system is currently facing a rise in the number of aging citizens, which is raising concerns about the quality of healthcare in Denmark. By 2036, it is expected that there will be an increase in the number of elderly people, as individuals aged over 80 is expected to nearly double compared to 2016 (Højgaard & Kjellberg, 2017).

When looking into predicted scenarios, the workforce in the age group of 15-64 is predicted to decrease by 2 % by 2040 when compared to 2019. This is despite that the Danish population is expected grow in this period. Demographic trends in Denmark indicate a reduction in the workforce and regional differences in the population composition predict that 81% of municipalities will experience a decline in the workforce by 2040. (KL, 2022)

However, during the same period until 2030, the public sector is also expected to require 44,000 more employees to maintain the same number of employees per user as in 2022. Furthermore, the demographic structure of Denmark is characterized by a higher proportion of older citizens categorized as citizens over the age of 65, compared to children categorized as the age of 0-14. This tendence of the inequality between older and younger citizens is expected increase. This are all leading to *"an increased demand for healthcare and elderly care"* (KL, 2022, p.7). The rise in healthcare expenses and demand is placing further pressure on the Danish healthcare system (Højgaard & Kjellberg, 2017).

2. The increasing prevalence of chronic diseases

Due to the aging population, the number of individuals with chronic diseases becomes increasingly prevalent in Denmark. Nearly a third part of the Danish population is diagnosed with one or more chronic diseases which is increased due the aging population. The rise in chronic diseases is also due to improved diagnostic methods which have resulted in previously serious diseases now are manageable chronic disease that are able to be treated. (Højgaard & Kjellberg, 2017).
One of the diseases expected to increase due to better diagnostics and the demographic change in the populations is dementia, leading to a significantly higher need for healthcare services. There is also expected a rise in patients having more than one chronic disease. Patients who have three or more chronic diseases results in 11 times higher healthcare expenses compared to patients without any chronic diseases (Højgaard & Kjellberg, 2017). As a result, to the aging population the prevalence of chronic diseases will rise the need for treatment from the healthcare system.

3. The information revolution

The information revolution has led to a significant increase in the amount of information and data available. This growth in data is predicted to transform the healthcare system leading to a need for new healthcare approaches. Automated tasks and advanced decision support tools is becoming more accessible to patients and healthcare professionals. These new digital solutions will require skill

development across all professional groups in the healthcare sector. Healthcare professionals will need support to handle the growing use of new technology and digital solutions (Højgaard & Kjellberg, 2017). This is leading to a higher amount of tracking of health data, rising the need for integrations new healthcare approaches and technologies. An effective data integration and skill development are essential for increasing the benefits from the information revolution.

4. The blessing and curses of clinical technology

The integration of technology in healthcare is bringing both blessings and curses. Technological advancements have led to significant growth in biological medicine and immunotherapy, promising more precise and effective treatments. However, these innovations also bring challenges, including high costs, the need for robust data infrastructures, challenges in integration, and new ethical dilemmas. This requires new competencies among healthcare professionals and careful management of genetic information. Balancing these benefits and challenges is crucial for the future of healthcare. While clinical technology can improve healthcare treatment, it presents challenges related to implementation, staff acceptance, and workflow adjustments. This is raising the need for initiatives that can help ensure the efficacy of digital health solutions (Højgaard & Kjellberg, 2017).

5. The new healthcare consumer

The healthcare consumers are predicted to change the healthcare system by a rise in expectations and having a more active role in personal health management. As digitalization emerges the healthcare sector, citizens will expect higher standards of care and greater involvement in their health services. Access to extensive health information will empower the main part of patients to become more informed and assertive about their treatment options. Health consumers will not only expect more from healthcare providers but will also take a proactive approach to managing their health. This trend will be facilitated by the emergence of digital health tools and technologies that enable patients to independently monitor and manage their conditions. The widespread adoption of digital health solutions has a great potential but also risks exacerbating health inequalities. While many individuals will readily embrace these advancements, others may struggle due to a lack of digital skill (Højgaard & Kjellberg, 2017).

This transformation rises the need for skill development and adoptation in general and especially among healthcare professionals as outlined in the following quote.

"Artificial intelligence and digital solutions will create a need for skill development across all professional groups in the healthcare sector. The concept of lifelong learning will become truly significant. Healthcare professionals will need to upgrade their skills to keep up with the increased use of new technology and digital solutions." (Højgaard & Kjellberg, 2017, p. 40).

The rise in technology integration and the healthcare consumers rising expectations for quality in care requires a successful integration of technologies and competency development of healthcare professionals' skills in this area.

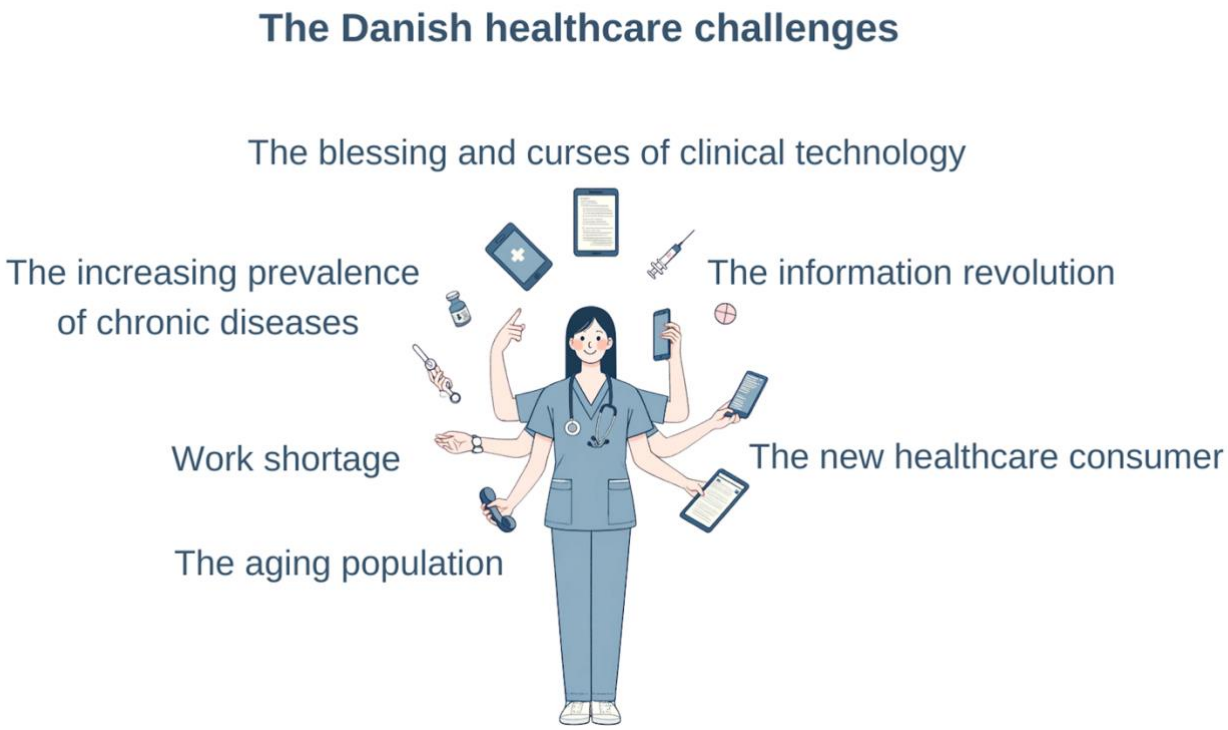
Exacerbating the issue: Work shortage

Exacerbating the issue, Denmark also faces a shortage of healthcare professionals. Nursing job positions from September 2021 to February 2022, 46% went unfilled, equivalent to 4,930 job positions. Looking ahead to 2045, the need for nurses is expected to increase by 19%. But while yearly annual intake of 3,000 nursing students seems to meet the future needs, completing a nursing education is not a guarantee that nurses will apply for nursing positions and stay in them (KL, 2022, p.8). The *Danish Ministry of interior and health* states that the healthcare system in Denmark experience a lack of capacity due to staff issues in a report, called *"Inspection of the healthcare system".* This is resulting in inability to provide treatment on time and a lower productivity in care treatment (Indenrigs- og Sundhedsministeriet, 2023b). The *Danish Medical Association* underlines that work shortages in the healthcare system is severe and call the problem "*the recruitment crisis*" and underline its consequences in the following quote: *"The lack of specialist doctors and other healthcare professionals runs deep, and ultimately, it affects the patients,"* (Lægeforeningen, 2023).

The problem of work shortage in healthcare might be an even bigger problem than earlier predicted. In the past four years there has been a 50 % rise in resignations among healthcare professionals. The article "Healthcare workers are leaving. Resignations have increased by 50 Percent in the past four years" (Sundhedsmonitor, 2024a), explains the reasoning behind this trend. It is argued that high work pressure, poor work environments and growing work-related stress experiences by healthcare professionals are the reasoning behind this trend of healthcare professionals reassigning. More of the healthcare professionals reassign without having a new plan for a job which is rising concerns as this underlines the sacrifice healthcare professionals are willing to take to find a new career

(Sundhedsmonitor, 2024a). A survey from *The Danish Medical Association* underlines that high workload in the healthcare sector is leading to a worsening in the patient treatment and a higher number of unintended incidents (Lægeforeningen, 2021). Highlighting the urgent need to address the issues of work shortages as it consequently affects the quality in patientcare.

The picture below titled "The Danish healthcare challenges" visually summarizes the issues increasing in the Danish healthcare system. At the center of the image is a healthcare professional with multiple arms is representing increasing the workload. The challenges include the aging population, the increasing prevalence of chronic diseases, the information revolution, the blessings and curses of clinical technology, the evolving expectations of new healthcare consumers, and the work shortage among healthcare professionals. This illustrates these issues and in the following section one of the political solutions to these is described.



Political initiatives to solve the Danish healthcare challenges

As a prelude to solve the challenges in the Danish healthcare system politically, *Robusthedskommissionen* (The Resilience Commission) was established in 2022. The political desire for the commission was to address healthcare and eldercare challenges and provide recommendations on how to solve these. They describe a paradox which revolves around how the

success of the healthcare system in Denmark, on one hand, the advancements in healthcare have led to longer life prospects and improved quality of life for many individuals. This success is celebrated as it reflects the effectiveness of healthcare interventions and treatments. However, this success also brings challenges as people live longer, they tend to develop more chronic illnesses and age-related conditions, which increase the demand for healthcare services and eldercare. This puts pressure on the healthcare system and its workforce, as they must meet the growing needs of the population (Indenrigs- og Sundhedsministeriet, 2023a).

Among the recommendations made to overcome the challenges in the Danish healthcare system, a noticeable focus is placed on the integration of technology. One of these recommendations is about prioritizing digital and technological solutions that are efficiency in saving time and resources. Additionally, there is a push to create better frameworks for the adoption of labor-saving technologies by removing structural and organizational barriers. Strengthening digital competencies and te technological understanding among healthcare staff is also one of their recommendations about integrating technology education into health professional training and creating roles that link clinical work with research and technology development (Indenrigs- og Sundhedsministeriet, 2023a). The Resilience Commission sums up the motivation and potential for the technological integration in healthcare in the following quote:

"Labor-saving technology can help relieve healthcare staff by taking over certain tasks, such as monitoring duties. Additionally, it can serve as a tool to support some patients and citizens in self-care and contribute to their treatment at home. In this way, technology can also act as a catalyst for more differentiated interventions that are tailored to the individual needs and resources of each citizen and patient." (Indenrigs- og Sundhedsministeriet, 2023a, p.114)

The report from the *Local Government Denmark* (KL) underlines that "*Welfare technology can save labor and improve quality for citizens"* while also underlining that certain requirement such as, implementing one new process at a time, should be considered carefully to ensure a successful implementation of technology in healthcare (Kommunernes Landsforening, 2022, p. 32). The organization of Danish Regions also identifies an acute staff shortage, and suggests among other initiatives that it needs to be solved through better conditions, pay, better sharing of knowledge, better interdisciplinary work, and better integration of technology (Danske Regioner, 2022). The integration of technology as a solution to Danish healthcare challenges might face additional

difficulties, as the adoption of technology in healthcare is often complex as outlined in the following section.

Challenges in implementing technology in healthcare

The article: "*Technology changes and challenges professional tasks, roles, and responsibilities. We must address this"* underlines the need to address the challenges in technology implementation healthcare expressed in the following quote:

> *"Despite the growing belief that new technology can future-proof the healthcare system, there are also significant challenges associated with implementation and value creation in practice."*
> *(Sundhedsmonitor, 2024b)*

Researchers caution against hastily adopting technology in healthcare without careful consideration of its cost and effectiveness. They emphasize the need for proper implementation and research into the effectiveness of digital health solutions. Hospitals face challenges in selecting and investing in health technology due to the absence of a national advisory body. The importance of thoughtful decision-making and thorough research before implementing health technology is expressed by the research manager at Center for Innovative Medical Technology at Odense Universitates Hospital:

""The fact is that you can easily buy some smart IT, but it is quite a way to go before the staff is ready to use it properly. There is a very large amount of work involved in the implementation. That is why it is also an area that is heavily researched."(Ugeskriftet, 2018a)

Introducing new digital solutions can bring implementation challenges. In line with this the article *"Good advice for the digitalization of the Danish healthcare system"* healthcare professionals' acceptance and the necessary adjustment of workflows are time consuming and cost resources. Implementation should be treated as a separate step, with a focus on training healthcare staff and integrating digital solutions effectively into existing healthcare services. Digital health technologies lack extensive regulation and evaluation processes resulting in each region, hospital, and clinician having to assess the evidence and research behind digital health technologies. While some digital treatments offer benefits for patients and healthcare systems, research and evidence-based decision-

making are crucial to ensure the success of digitalization efforts in the Danish healthcare system. (Ugeskriftet, 2018b). Technological quick fixes cannot alone solve the critical work shortage of healthcare professionals in Denmark. The politically increased demand for healthcare technologies raises a need for educations in digital health technology supporting effective technological healthcare solutions (Langstrup and Gjødsbøl, 2023)

The integration of technology in healthcare presents both opportunities and challenges, impacting professional tasks, roles, and responsibilities. Careful consideration and thorough evaluation before adopting new technologies is addressed, highlighting the need for proper implementation and research in digital health solutions. In the following section research articles on the factors influencing the implementation of technology in healthcare is unfold.

State of the art

Given the severe challenges in Danish healthcare including work shortage and demographic changes. In response political initiatives have emphasized the role of digital solutions and welfare technologies in addressing these challenges. However, the successful deployment of these technologies is needed to overcome significant implementation challenges.

To capture the scope of research on healthcare technology adoption, *PubMed* was chosen as the database due to its specialization in the field of healthcare research articles (PubMed, 2023).
The aim of the search was to collect research articles about trends, challenges, and facilitators in healthcare technology implementation and include perspectives from healthcare professionals. The following figure illustrates the search string:

Topic	Keywords
Scope of technology	“Electronic health records” OR “Digital health technologies” OR “Health information technology”
Focus on aspects of integration	“Technology integration” OR “Technology adoption” OR “User involvement” OR “Stakeholder involvement” OR “adoption” OR “influence”
Implementation factors	“Implementation” OR “Usability” OR “Workflow integration” OR “Organizational culture” OR “Training” OR “Support” OR “Mental workload”
Target group	“Healthcare professionals” OR “Healthcare workers” OR “Nurses” OR “Physicians” OR “Medical staff” OR “Clinical staff”
Exclusion Criteria	NOT “Patients”
Time Frame	“Last 5 years” [PDat]

Figure 1 Search string

The scope is narrowed down from a more general understanding of technologies in healthcare to digital technologies. To delve into specific implementation factors, the search includes terms related to usability, workflow integration, organizational culture, training, support, and mental workload. The target group i.e., healthcare professionals included nurses, physicians, and clinical staff, to gather insights from users of digital healthcare technology. Studies focusing on patients were excluded to scope the focus to primary be users of digital healthcare technologies in the process of implementing these. Limiting the search to the last five years ensures the inclusion of the most recent and relevant article. The search resulted in 162 results where most of the following articles were found. A few of the research articles are found through a snowball approach, by reviewing references from research articles found from the search string.

Research articles and insights

The article *"Barriers and facilitators to utilizing digital health technologies by healthcare professionals"* (Borges do Nascimento et al., 2023) is identifying barriers and facilitators that healthcare professionals experience when adopting to digital health technologies. They found that these barriers included infrastructure issues, resistance to change, and increased workload. Facilitators was found to be training, positive perceptions of technology, and support from the government and organizations. The study emphasized the importance of addressing both technical and psychological barriers to improve technology adoption (Borges do Nascimento et al., 2023). These findings address factors such as training, impacting technology integration across healthcare stakeholders.

In the research, *"Involving Health Care Professionals in the Development of Electronic health records: Scoping review"* (Busse et al., 2023) it was aimed to explore various approaches to user involvement in the development of Electronic Health Records and provide insights into their effectiveness. The study highlighted multiple user involvement methods such as think-aloud sessions, interviews, and prototype testing. They found that involvement of healthcare professionals was limited while they also found that this is needed to provide better quality standards and consistent reporting in the development of Electronic Health Records (Busse et al., 2023). This article is providing an understanding of the importance of involving healthcare professionals in the

development of Electronic Healthcare Records to ensure these systems are effectively integrated into healthcare professionals' workflows.

The article *"Workflow interruption and nurses' mental workload in electronic health record tasks: An observational study"* (Shan et al., 2023), examines the impact of workflow interruptions on nurses' mental workload and task performance during Electronic Health Record tasks. They found that workflow interruptions significantly increased nurses' mental workload and negatively affected their task performance. Factors influencing mental workload included task difficulties, system usability, and individual professional experience (Shan et al., 2023). This article provides insights into the practical challenges of electronic health records implementation, emphasizing the need to reduce interruptions and improve system usability to enhance performance and reduce mental workload among nurses.

The article "*Sociotechnical Challenges of Digital Health in Nursing Practice During the COVID-19 Pandemic: National Study"* (Livesay et al., 2023), is exploring the sociotechnical challenges faced by nurses applying digital health technologies during the COVID-19 pandemic in Australia. The study identified several technical challenges, including interaction issues. It also highlighted the need for user-friendly interfaces and continuous training of healthcare professionals' technical competencies (Livesay et al., 2023). The findings underscore the importance of addressing technical and competence challenges to ensure successful digital health integration which became even more clear after the COVID-19 pandemic.

The article *"Nursing workforce competencies and job satisfaction: the role of technology integration, self-efficacy, social support, and prior experience"* (Alshammari and Alenezi, 2023), explores the impact of nursing training and technology integration on nursing competencies and job satisfaction. They found that effective technology integration and training significantly enhanced nursing competencies and job satisfaction. Self-efficacy and social support were identified as mediators, highly affecting technology adoption (Alshammari and Alenezi, 2023). This article highlights the critical role of technology integration and training in improving healthcare outcomes. The healthcare professionals level of self-efficacy seemed to be a facilitator in the process of implementing technologies.

The article *"The role of organizational culture in health information technology implementations: A scoping review"* (Rajamani et al., 2021), examines the impact of organizational culture on the implementation of health information technology. The review identified organizational culture, leadership engagement, and resource availability as significant factor influencing health information technology implementation. Stressful work environments were a barrier to the implementation while leadership engagement facilitated successful implementations (Rajamani et al., 2021). This article provides valuable insights into the cultural and organizational factors that can either facilitate or hinder health information technology implementation.

This section has provided research providing various factors influencing the integration of new digital technology in healthcare. This has led to the research questions of this study, presented in the following section.

Research questions

The literature review has identified factors influencing technology adoption and implementation including barriers and facilitators, user involvement methods, the impact of workflow interruptions, and the role of organizational culture. Building upon the insights gathered from the presented research articles and given the significant challenges the complexity and nuances of digital technology implementation is clear. The Danish healthcare system is under considerable pressure due to the aging population, the increasing prevalence of chronic diseases, the information revolution, the blessings and curses of clinical technology, and the evolving expectations of new healthcare consumers. Coupled with a severe shortage of healthcare professionals, these challenges necessitate solutions. The political motivation on integrating healthcare technology to address the workforce shortage underscores the critical role of digital solutions. Yet, successful integration of technology in healthcare is not without its challenges. It requires careful considerations for the implementation to be successful. Looking deeper into the factors influencing the integration of technology based on the presented aspects of the implementation the following research questions are formulated:

Problem statement:

What factors impact the integration of digital technologies across different stakeholders in hospital settings and how do these factors influence the implementation of digital technology in healthcare?

Research question:

a) *What do healthcare stakeholders see as important factors when implementing digital technology in healthcare?*

b) *How do nurses at the Neurological Ward in Nordsjællands Hospital perceive the adoption of Teton.ai. and what factors influence them in the process of adopting this new digital technology?*

The research questions formulated in this thesis aim to outline the factors influencing the adoption and implementation of digital technology in hospitals. By investigating the perspectives of healthcare stakeholders and frontline healthcare professionals, it is pursued to uncover insights about these dynamics, through a Techno-Anthropological lens. In the next section the qualitative methods for obtaining these insights will be presented.

Method

In this section the methodological approach will be unfold and the considerations behind the choice of method will be covered. This study employs a qualitative research design, more concretely semi-structured interviews, ethnographic fieldwork, and a survey. This approach is chosen to get various insights on the factors influencing integration of digital technology in hospitals. Kvale and Brinkmans 7 phases i.e. *thematization, design, interview transcription, analysis, verification and reporting* (Kvale andBrinkman, 2015), is applied as a framework for structuring the interviews and ethnographic fieldwork. Taking inspiration from the 7 phases has helped organize the findings and analyze what the informants expressed about the implementation of digital technologies. The interviews with health stakeholders provide organizational and structural insights on technology implementation in healthcare while the ethnographic fieldwork offers real-world insights through observations and informal conversations with healthcare professionals. The survey provides data from a broad range of healthcare roles, giving further perspective to this study. This methodology allows for an exploration of the challenges and opportunities in adopting new digital technologies in healthcare settings, outlined more detailed in the following sections.

Semi-structured interviews

Semi-structured interviews are characterized by a combination of predefined questions while keeping a flexibility for exploring emerging topics during the conversation. This approach ensures that the some of the prepared questions are addressed while allowing the informants to guide the discussion toward areas of personal interest to the topic. Qualitative interviews offer detailed descriptions of the informant's knowledge, experiences, as well as their opinions and values related to the interview topics (Kvale & Brinkmann, 2015).

To dive deeper into the process behind the implementation of digital technology in hospitals the interviews were chosen as a method. More precisely the semi-structured approach was chosen as this allows for a flexible exploration (Kvale & Brinkmann, 2015), of the health stakeholders perspectives on the implementation of digital technologies in hospitals. Semi-structured interviews were chosen as an approach to outline the nuances in the process of integrating technology. Semi-structured interviews are suitable as a method for this project as the method allows for the

exploration of both predefined questions and emerging topics that arise during the conversation. This flexibility ensures that the interviews cover the essential questions to make sure to gain insights about the factors influencing the integration of digital technologies while still strive to capture unprepared topics from the informants. The interviews were conducted online in the timeframe of 60 minutes as this was most feasible to schedule for the informants.

Selection of informants

For the interviews, health stakeholders involved in different aspects of technology evaluations, decision-making and implementation of technology in healthcare were invited as informants. The reasoning behind this choice was to capture a deeper understanding of the decision-making behind the integration of new technologies in healthcare and unfold some of these. The interviewed organizations are presented below:

The Danish Health Technology Council (Behandlingsrådet) was established by the Danish Regions in 2021. The background was for them to direct healthcare resources towards technologies and interventions that deliver more health for the same amount of expenses. Its primary goal is to improve the efficiency and quality of healthcare services by promoting the use of cost-effective solutions. The council conducts systematic evaluations focusing on the effectiveness, costs, legality, ethics, and safety of medical technologies and healthcare solutions (Behandlingsrådet, n.d.).

Research and Innovation of Rigshospitalet focuses on developing new healthcare solutions that improve patient care. They encourage innovation through a collaborative approach, involving healthcare professionals in the creation and implementation of new methods and technologies. By providing necessary resources and support and translating ideas into practical healthcare improvements (Rigshospitalet, n.d.).

Copenhagen Health Innovation (CHI) works on strengthening the healthcare system by fostering health innovation through education. CHI collaborates with the Region's leading educational institutions in health to develop creative solutions that improve

healthcare quality and patient care. They focus on combining practical experiences with academic knowledge to enhance students' skills in innovation and entrepreneurship, thereby preparing students for the increasing innovative initiatives in the healthcare (Copenhagen Health Innovation, n.d.)

Center for IT and Medical Technology (CIMT) at Region Hovedstaden focuses on enhancing healthcare through advanced technology. Digital solutions developed by CIMT aims to improve prevention, treatment, and research. Their initiatives include collaborating with hospitals, suppliers, and other regional organizations to create better patientcare by, integrating high-tech solutions such as telemedicine, advanced diagnostics, and robotic surgeries, while emphasizing agile development processes and robust operational support. (Region Hovedstaden, n.d.)

Emails introducing the topic of the master thesis were sent to various stakeholders, and the organizations listed above, and the organizations presented is chosen both on behalf of relevance and behalf of availability. One informant represents each of the above-mentioned organizations except from Research and Innovation of Rigshospitalet where two informants are represented.

Interview guide

The figure below presents the topics from the interview guide applied for the interviews with health stakeholders. The guide was structured to have a framework for the topics that could be relevant considering the informants professional context in the integrations process of digital health technology in healthcare. The interview guide is applied during the interviews as a framework and structure while having a flexibility to explore other themes. This approach was beneficial in having a structure and prepared questions to ask, while the informant could bring up topics to be elaborated. Therefor the interview guide was not followed strictly but relatively depending on the conversation. The topics from the applied interview guide is seen in figure 3:

Interview guide overview	
Introduction	Interview purpose and structure Time frame audio recording and anonymization
Presentation of the informant	Role description Educational and professional background
Digital literacy	The informant's definition and understanding of digital literacy
Assessment of new technologies	Top-down vs. bottom-up approach Decision-making process for acquiring digital technologies Identification of needs for new digital technologies The purpose of new digital technology Evaluation criteria for potential digital technologies
Implementation process	Experience with implementing new digital health technologies Typical implementation process Examples of successful implementations Challenges in technology implementation and solutions
Technology and healthcare professionals	Pros and cons of integrating digital health technologies into healthcare professionals' work Ensuring engagement from healthcare professionals Strategies for acceptance of new technologies Addressing resistance or lack of interest from healthcare professionals
Digital and technological competencies	Need for further training in the implementation and assessment of digital health technologies Methods for providing additional training if needed
Evaluation and impact	Timing and methods of evaluating new technology implementations Specific tools and methods for assessing the effectiveness and value of new technologies Examples of technology evaluation and subsequent actions
Sustainability	Contribution of digital health technologies to the green transition Consideration of sustainability aspects in technology selection Involvement of healthcare professionals in sustainability considerations
Potential and opportunities	Vision for the future contribution of technology assessment to the healthcare sector Improvements for successful technology implementation The factors influencing the success of new technologies in healthcare
Wrap-up	Additional comments Expression of gratitude and repetition of anonymity Offer to send the completed task upon request

Figure 2, (Appendix, Interview guide)

In the end of the interview guide in the topic called *Potential and possibilities* in the figure, a question is inspired by a workshop method called *"The fantasy phase"*. The thought behind this method is to invite the interviewee to think of a scenario where limitations a put aside, which is known to be a method suitable to start idea generation (Vidal, 2005). This was incorporated to facilitate idea generation to the addressed challenges in implementation of technology that was addressed by the informant during the interview.

Following Kvale & Brinkman building trust and reciprocity is an important concept when collecting qualitative data, such as semi-structured interviews. (Kvale and Brinkman, 2015). The concepts of

reciprocity were applied throughout the interview process. As a reciprocity for the informant's time, knowledge, and shared experiences, they were all informed to be provided with the outcome of this project. All the informants expressed to be very interested in the topic of digital technology implementation in hospitals and expressed appreciation in gaining the results of this project.

Transcription

The automated GDPR compliant transcription software, My Good tape, generating transcripts based on audio recordings (Good Tape, n.d.). To ensure the quality of the transcriptions, all the interviews are listened and read through after this application of My Good Tape. Correction of this automated transcription were made, and the quotes chosen to incorporate in this study were listened through again to ensure they were as close as possible to the original words said during in the interview.

Ethnographic fieldwork

The ethnographic fieldwork for this study was conducted over two days at the Neurological Ward at Nordsjællands Hospital. Short-term ethnography emphasizes intense, focused data collection over a brief period following Pink and Morgan. This method is outlined to be particularly suitable for doing ethnography in healthcare considering that it is more suitable with shorter engagement while still aiming to address insights (Pink & Morgan, 2013). The aim was to observe the real-world application of Teton.ai, a healthcare technology designed to alleviate workloads and improve patient care. Given the limited time frame, short term ethnography allowed for a focused data collection process that provided valuable initial insights into the integration and perceived benefits of the technology.

I was firstly introduced to Teton.ai. through my network some years ago and learned more about the product when participating in a summit called *"Driving Health Tech 2024"*. The administrative director of Teton.ai. presented the technology at a presentation called *"AI as support for the healthcare professionals of the future"* (IDA, 2023). Afterwards I contacted Teton.ai. and they helped me get in contact with the nurse manager at the Neurological ward in Nordsjællands Hospital where Teton.ai is newly implemented. Considering this hospital setting it was most feasible to conduct the data over a short period to not disturb their daily work too much. Over two days, short informal conversations with healthcare professionals and observations of their interactions with the Teton.ai system was conducted. This intense focus provided insights into the

factors influencing the healthcare professional's adoption of Teton.ai and understanding of how the technology was perceived by some of the healthcare professionals.

The conversations with the healthcare professionals were inspired by semi-structured interviews. Semi-structured interviews can help provide information about experiences (Kvale and Brinkmann, 2015). As the aim of doing ethnographic fieldwork at the Neurological ward was to investigate the factors influencing the healthcare professional's adoption of Teton.ai. this method is suitable for this study.

The framework for the conversations were inspired partly by the interview guide applied for the interviews (Appendix, Interview guide) and the Technology, People, Organizations, and Macroenvironmental factors (TPOM) framework. The aim of the article "Developing and applying a formative evaluation framework for health information technology implementations: qualitative investigation" (Cresswell et al., 2020), was to develop and apply an evaluation framework for human interaction technology implementations. The method behind the development of the TPOM framework is based on a literature review exploring what the factors are for effective implementation of technology. In the research they included qualitative data from evaluations of different Human information technology implementations. The study included 19 case studies from hospitals involving 703 interviews, 663 hours of observations and 864 documents collected from various care settings in National health services in England and Scotland conducted over a 10-year period . The TPOPM framework questions consists among others the "Social/human factors" (Cresswell, K., Williams, R., & Sheikh, A, 2020).

In this case healthcare professionals are investigated as the users of this technology why it was found relevant to draw inspiration from these when doing ethnographic fieldwork and talking with the healthcare professionals about their experience in applying Teton.ai. The following figure illustrates the *Social/human factors* from TPOM framework that inspired the questions:

Social/human factors	
User satisfaction	Who are the users? Are users satisfied with the technology?
Complete/correct use	Are features and functionality implemented and used as intended?
Attitudes and expectations	What benefits do users expect from using the technology and how can these be measured?
Engagement	Are users actively engaged in implementation, adoption, and optimization?
Experiences	Do users have negative experience with previous technologies?
Workload/benefits	Are the benefits and efforts relatively equal for all stakeholders?
Work processes	Does the system change relationships with patients, patterns of communication, and professional responsibilities (eg, increase of administrative tasks)?
User input in design	Is there effective communication between designers, information technology staff, and end users, as well as between management and end users?

Figure 3(Cresswell et al., 2020, Table 3)

Ethnographic fieldwork was chosen as a method to conduct data about a real-world application of a healthcare technology. In the following section the case is explained more thorough and the reasoning behind choosing Teton.ai. as the case for this project is outlined.

Introduction to the case

Why is Teton.ai chosen as a case in this project?

Due to the described healthcare crisis in the introduction, work shortage combined with a higher workload is leading to the choice of prioritizing healthcare technology optimizing work for healthcare professionals. To exemplify such technology Teton.ai is chosen to study as a case in this project. Tetotn.ai aim to alleviate heavy workloads and shortages in healthcare by offering real-time insights and automating routine tasks (Teton.ai, 2024a).

What is Teton.ai?

Teton.ai was founded in 2020 and their mission is to support nurses and healthcare professionals facing heavy workloads and global shortages. By providing real-time insights and automating routine tasks Teton.ai see a potential for their solution to revolutionize the healthcare sector, enabling healthcare professionals to focus more on core tasks and herby deliver a higher quality in care for patients (Teton ai, 2024a).

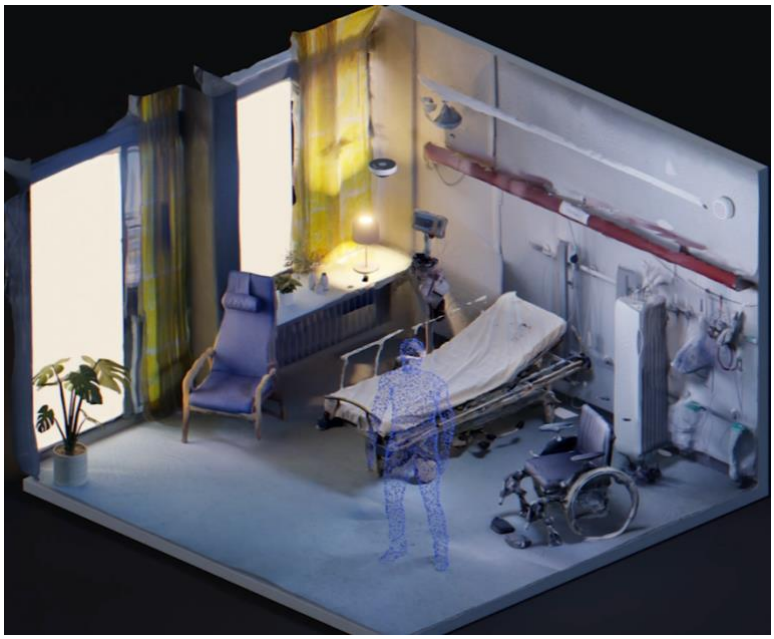


Figure 4 (Teton.ai,2024a)

The patient is detected as visualized in the illustration above by the sensor that is on the wall to the right on the picture. Regarding privacy and anonymity all the calculations are performed locally and privately. Access to recordings is restricted and once data is processed image files are promptly deleted. Encrypted and protected behavioral data can be shared if the patient allows this for example to see where a patient was hurt from a fall. No videos are accessible through the interface to respect staff and patients' privacy (Teton.ai, 2024b).

The system can detect falls and detect monitor sleep patterns, assist with routine task documentation, alert staff for if high risk fall patients, and offer long-term insights into patient's behavior. Below is a visualization of how the healthcare staff can monitor the patients.

Figure 5 (Teton.ai, 2024b)

Statistics have demonstrated a positive impact on healthcare professionals and patients as the implementation of Teton.ai have led to enhanced patient safety and reduced workload for health care professionals. The implementation of Teton.ai. has led to 25 % decrease in workload experienced by healthcare professionals during night shifts. By implementing Teton.ai in nursing homes there has been an increase of 40 days compared to the expected life span of the patients. Furthermore, a significant reduction in patient falls is reported after the implementation of Teton.ai. The reported decrease in patent falls is 67-84% indicating the system's ability to monitor patient activity and provide alerts for healthcare professionals which have helped preventing accidents and improved patient safety (Teton.ai, 2024a).

At the Geriatric medical ward at Nordjyllands Regionshospital they have installed the Teton.ai system and collected data 21 days before the implementation and 87 days after the implementation for comparison. They compared the data to see the results of the implementation. The time a patient remains on the floor after a fall has been reduced by 68% and the staff's reaction time is improved

by 74 %. They also noticed even more improvement during the 87 days as the staff got more familiar with the functions of the system (Regionshospital Nordjylland, 2023).

The company is rapidly growing and is being implemented at multiple hospitals and nursing homes across Denmark and Europe. After the implementation of Teton.ai in *Næstved Municipality*, they have received the national *"Digitalization award for innovation in the public sector"* where the center manager described Teton.ai. to be *"Probably the best implementation in healthcare I have seen or heard of"* (Teton.ai, 2024a).

The implementation of Teton.ai. at the Neurological ward at Nordsjællands Hospital

The Teton.ai. system was implemented the Neurolological Ward at Nordsjællands Hospital in December 2023. The plan is that the system is being tested in 24 patient rooms for a duration of six months. In this testing phase, data are collected and observed to allow an understanding of the systems effectiveness (Nordsjællands Hospital, 2004)

Figure 6Picture from fieldwork at Nordsjællands Hospital

Data collection

The ethnographic fieldwork was conducted at the Neurological Ward at Nordsjællands hospital, involving informal conversations with healthcare professionals at the ward and observations capturing the environments and integration of Teton.ai.

This method was chosen to get an understanding of how the healthcare professionals interact with Teton.ai. Due to time perspectives the unformal conversations were short and took place with healthcare professionals at the nursing office and in the lunchroom when they had a few minutes in between work tasks. After each conversation detailed notes were taken to explain the main points of the conversations about the healthcare professional's perception of the Teton.ai. system. Furthermore, I was observing the healthcare professional's interaction with the Teton.ai. system. Regarding reciprocity, the findings from this study is offered to the Neurological Ward, at Nordsjællands Hospital, as this also was something the nurse Manager showed interest in.

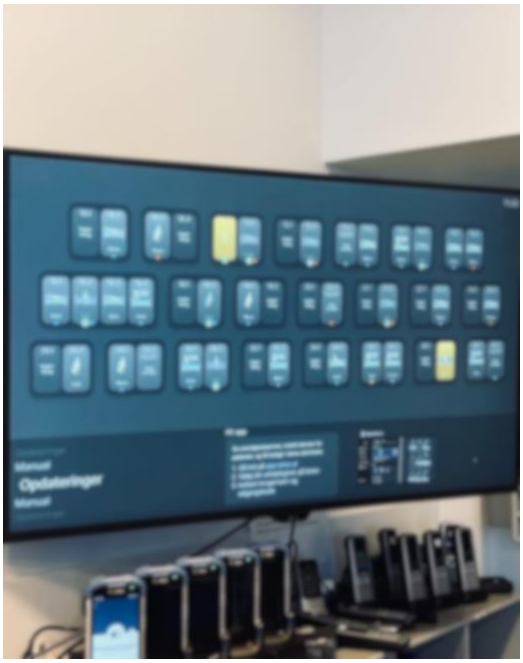


Figure 7 Blurred picture from the nursing office at the Neurological Ward at Nordsjællands Hospital, showing the Teton.ai. monitoring screen

Processing empirical data from interviews and ethnographic fieldwork

Regarding privacy both the health stakeholders and healthcare professionals are only mentioned by their job position and not their name. This is chosen as their name is not relevant for the empirical findings and to consider their privacy.

A thematic approach has been applied to analyze the data conducted from the semi-structured interviews with decision-makers and the ethnographic fieldwork conducted at the Neurological ward at Nordsjællands hospital. The thematic analysis draws inspiration from analysis phase by Kvale & Brinkmanns 7 phase (Kvale and Brinkmann, 2015). In this study the transcriptions and the fieldwork notes were separately coded. In this process themes and patterns were identified, focusing on the factors influencing the integration of technology in healthcare.

The thematic analysis was chosen for its ability to systematically identify and interpret the themes conducted from the empirical data. Combining semi-structured interviews with ethnographic fieldwork, the analysis captured both structural insights and practical experiences. Providing an understanding of the factors influencing technology integration in hospital settings, grounding the findings in real-world observations and health stakeholders' experiences.

Survey

A survey was conducted to gather insights from healthcare professionals on their involvement and experiences with the implementation of new technology in the healthcare sector (Appendix, Survey) This was chosen to add perspectives on this topic. The survey included both questions where it was possible to pick from selected answers and open questions to capture a descriptive approach. The survey was created using Survey Monkey (Survey Monkey, 2024). The included questions were about the current role of the respondents in the healthcare sector, and their involvement in technology implementation. Furthermore, the survey enfolded topics as whom they approach with new ideas, types of technology they have been involved with, their experiences, challenges, suggestions and perceived importance of involving healthcare professionals in technology implementation. The survey was shared electronically, on social media (LinkedIn, Instagram, Facebook) and respondents working in the field of healthcare were invited to participate.

Type of case

Bent Flyvbjerg argues that it is possible to generalize from a single case study and herby challenges the conventional view on case studies, being the opposite. He underlines that case studies can provide unique context dependent knowledge and therefore contribute with valuable in-situ knowledge. Especially when studying humans' behavior, it is crucial to have practical knowledge and a case-study can be a good method to gain this (Flyvbjerg, 2006).

The methodical choice of doing a case study i.e., studying the implementation of Teton.ai, aligns with Bent Flyvbjerg approach in applying case studies to understand a phenomenon within a practical context. Bent Flyvbjerg also explains this with the concept of black swans about that if it is claimed that all swans are white then only the observation of one black swan can falsify this hypothesis. This underlines that when studying specific cases in detail this can help gaining a deeper understanding of human implications (Flyvbjerg, 2006).

Flyvbjerg categorizes different types of case studies, each with a different strategic purpose for selection: *The Extreme/Deviant Cases, Maximum variation cases, Critical cases, Paradigmatic cases*. The critical case is defined as a case aiming *"To achieve information that permits logical*

deductions of the type, "If this is (not) valid for this case, then it applies to all (no) cases." (Flyvbjerg, 2006, p. 230).

For this study, the implementation of Teton.ai at the Neurological Ward at Nordsjællands Hospital is selected and argued to categorize as a *Critical case*. This is based on the strategic importance of understanding how a specific healthcare technology can address the pressing issue of workload and staff shortages in a real-world hospital setting. This is only based on empirical findings from one case why there needs to be some consideration in generalizing from it. Though following Flyvbjerg's theory *Critical cases* may provide insights that can be added or compared to other cases about integrating technology in healthcare. This approach allows for a detailed exploration of experiences and perceptions of technology integration in healthcare contributing with knowledge to the field of technology implementation in healthcare.

Ontology

Hermeneutic approach

This study is approached with a hermeneutic perspective, as the understanding of the implementation of technology in healthcare is done through interpretation of both me as a researcher with a nursing background and when investigating the participants' perspectives.

In the article "Heideggers hermeneutic circle: a Possibility for interpreting nursing care" (Sebold et al., 2017) it is argued that by reflecting on the nurses' experience and knowledge about care it can provide a deeper understanding of the nurses' role and actions as explained in the quote below:

> *"Heidegger's hermeneutic circle is constituted as a way of understanding and interpreting the nurse-being in the experience of care. Structured pre-understanding based on care experiences, in addition to studies about it leads to an understanding of the nursing way-of-being"* (Sebold et al., 2017, p.7)

Being clear about how my background as a nurse studying Techno-anthropology have shaped this study is important to provide transparency. My preconceptions as a nurse have allowed me to

understand the field while acknowledging that pre-conceptions and pre-understandings have have affected the study. Having this practical knowledge of the field have been beneficial in having knowledge about healthcare professionals work and their work environment. However, this can also be seen as a potential bias as my own experience with the implementation of healthcare technology can have an influence on the collected data. Although when weighting this bias, the contribution of having a background as a nurse is argued to be highly beneficial for this study as it has provided an understanding of the studied field which would have been difficult to gain without the experience.

The article *"Examining researchers' pre-understandings as a part of the reflexive Journey in Hermeneutic research "(*Maxwell et al., 2020), emphasizes the importance of explicitly acknowledging and examine pre-understandings in hermeneutic research. This allows researchers to engage in deeper more nuanced understandings (Maxwell et al., 2020). Being explicit about pre-assumptions and pre-understandings have enabled me to draw on my experience from working in healthcare.

The hermeneutic circle emphasizes this iterative process of understanding a phenomenon through continuous moving as illustrated below:

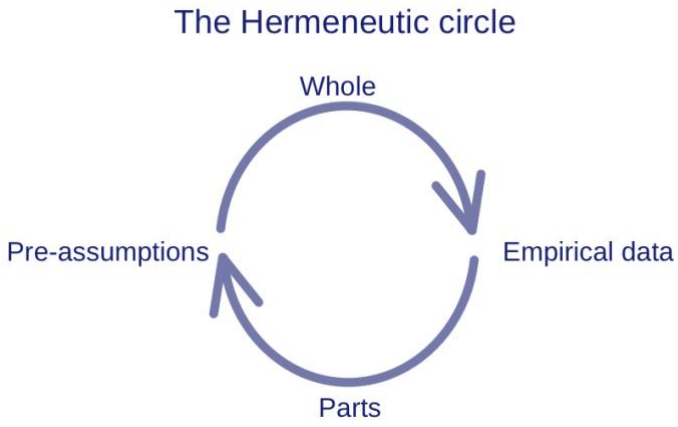


Figure 8 Illustration of the Hermeneutic circle

The dialectic approach of moving between the whole and the parts, i.e., between pre-assumptions and empirical data, ensures the study remains open to new insights and themes. This integration has contributed to an understanding of the factors influencing the adoption of technology in healthcare. The hermeneutical approach is chosen to continuous reflection on the empirical data.

Epoché

While being transparent about how pre-assumptions have influenced this study, the concept of Epoché is added with the goal of limiting pre-assumptions to become too dominant when conducting the empirical data. Epoché, is a phenomenological approach that involves suspending judgments and preconceptions to see aim to see phenomena as close to what it is (Moran, D., 2000).

In nursing education, Epoché is applied to aim to understand patients' actual perceptions (Løgstrup, 2019). Incorporating this term when interviewing and doing fieldwork has helped me to be open to new findings, reaching to minimize biased and strive to as accurately as possible reflect the participants' experiences. Applying the thought of Epoché during interviews and observations enabled me to strive to maintain an open viewpoint on what they experienced. In this project, I was introduced to the issue of work shortages and the challenges of implementing new technologies in the Danish healthcare system, as mentioned in the Problem field. Specifically, it was highlighted that there are significant hurdles and frustrations experienced by healthcare professionals during the integration of new technologies. To investigate these challenges as they are truly experienced by the healthcare professionals, the term Epoché is applied when conducting the fieldwork, by trying to but these pre-assumptions aside in this part of the research process.

Integrating the hermeneutical approach and the concept of Epoché, ensures a balanced exploration of the implementation of technology in healthcare, combining both reflexivity and openness to new insights. It ensured that the data collected reflected the participants' authentic views and not my interpretations influenced by prior knowledge or assumptions.

Findings

Semi-structured interviews

This section presents a short recap of the findings from the empirical data collected through the semi-structured interviews with health stakeholders in the integration of technology. To provide a clear overview of the findings from the semi-structured interviews, the themes from the thematic analysis is presented below:

Theme	Explanation of theme
Efficiency is prioritized	Stakeholders prioritize efficiency and cost-saving over quality when evaluating new healthcare technologies. Time-saving technologies often receive higher funding priority
High quality standards can prolong the process of implementation	The need for solid evidence and validation can slow down the implementation process for new healthcare technologies, in line with the standards in the pharmaceutical industry.
Prestige vs practicality	The implementation of certain healthcare technologies can be driven by political motivations and prestige rather than practical efficiency, leading to the implementation of high-visibility projects without necessarily meeting clinical needs.
Barriers to successful implementation and scalability	Various barriers, including integration challenges, economic constraints, and difficulties in transitioning from research to practical application, hinder the successful implementation and scalability of healthcare technologies
Creating a culture of innovation and balancing innovation with practicality	Fostering a culture of innovation while balancing practical needs is essential. Stakeholders emphasized the importance of creating an environment that encourages healthcare professionals to contribute effectively and suggested stronger regional collaboration and the establishment of technology centers to include healthcare professionals in this process.

Figure 9 Themes from interviews with health stakeholders (Pers.Comm.)

These expert interviews provide insights into the factors influencing the implementation of technology in healthcare, highlighting the conditions under which these technologies are implemented. In the analysis the quotes from the informants will be presented to unfold the themes more detailed.

Ethnographic fieldwork

This section presents key findings from ethnographic fieldwork conducted at the Neurological Ward of Nordsjællands Hospital, focusing on the healthcare professionals' experiences and interactions with the Teton.ai system. An overview of the findings from the thematic analysis is presented below:

Theme	Explanation
Work shortages and heavy workload	The fieldwork revealed that healthcare professionals face significant work shortages and heavy workloads. High patient volumes and insufficient staff were common, leading to multitasking and added pressure on the staff
Teton.ai supports patient care prioritization	Healthcare professionals reported that Teton.ai helps in prioritizing and managing patient care more effectively, especially during night shifts when staff is reduced. The system's ability to categorize patients by the urgency of their needs was particularly appreciated.
General technological skills affect adoption	The ability to adopt to the Teton.ai system was influenced by healthcare professionals' general technological skills. Those with more familiarity and interest in technology, often younger staff, adopted more quickly and found the system easier to use.
The domino effect	The adoption of Teton.ai spread progressively among staff. Early adopters, often the ones with good technological skills, acted as role models, demonstrating the system's benefits, and encouraging others to follow.
Quality over time	Nurses emphasized that the primary benefit of Teton.ai is improving the quality of care rather than saving time. While time-saving benefits might emerge indirectly, the immediate impact is seen in enhanced patient safety and better task prioritization.
The extra set of eyes	Teton.ai has positively impacted the work environment, providing an "extra set of eyes" during night shifts, and reducing stress by allowing nurses to monitor patients distantly. This capability helps prevent falls and other incidents, contributing to patient safety and more efficient workplace.
Navigating alarms	While the Teton.ai system's alarms are crucial for patient care, managing multiple devices and alarms can be challenging. Integrating the system with other devices could improve workflow efficiency and reduce alarm fatigue.

Figure 10 Themes ethnographic fieldwork at the Neurological Ward in Nordsjællands Hospital (Appendix, Fieldnotes and observations)

These findings highlight the context and impact of Teton.ai's implementation at the Neurological Ward, in the analysis a more detailed description of each theme is presented through quotes collected at the Neurological ward.

Survey

This section shows the results from the conducted survey where healthcare professionals participated, representing a diverse range of roles. With the survey it was aimed to gather insights into their involvement and experiences with the implementation of new technologies in their workplaces. The quantitative data is summarized using percentages, while qualitative responses from open-ended questions is presented as seen in the figure below:

Theme	Results
The respondent roles	Majority were nurses 44.12%, Doctors constituted 14.71%, The remaining respondents included other healthcare professionals from various fields including social and healthcare assistants, physiotherapists, radiographers, medical secretaries, occupational therapists, paramedics, biomedical analysts, students, and others.
Involvement in technology implementation	73.53% of respondents have been directly involved in the implementation of new technology at their workplace
Points of contact for solutions	70.59% of respondents would reach out to their immediate supervisor if they had a solution idea for their workplace
Types of technology involved	Respondents have been involved in implementing various technologies including: E-health platforms, Medical equipment, Diagnostic tools, Patient monitoring systems and Telemedicine.
Experience with technology implementation	44.12% rated their involvement in technology implementation as 'good' or better A notable percentage experienced less favorable involvement Implementation
Challenges in technology implementation	Challenges identified included: Lack of training 64.71%, Technical issues 52.94%, Resistance to change 64.71%, Insufficient time to adopt 73.53%
Suggestions for improvement	Participants suggested several ways to improve technology implementation: Forming groups with hands-on experience and including users before final decisions Greater involvement in development and design phases Comprehensive involvement and training sessions Mandatory introductory courses for all new employees Including relevant specialties in evaluations and continuous reporting Strong leadership support and clarity from top management Involving employees in decision-making processes regarding implementation Dedicated training time for new technologies like lasers Better training on technology and access to knowledgeable individuals
Importance of professional involvement	82.35% of respondents believe it is very important to involve healthcare professionals in the implementation of new technology

Figure 11 Overview of results from survey (Appendix, Survey)

The survey findings highlight the critical role of healthcare professionals in the successful implementation of new technologies. The majority of the respondents have been involved in such implementations and have faced challenges like lack of training, technical issues, and resistance to change. They emphasize the need for better training, greater involvement in decision-making, and strong leadership support to enhance the integration of new technologies in healthcare settings.

Theory

In this study, socio-technical theories provide a foundational lens to understand the complexities of technology adoption in healthcare. A Socio-technical approach is particularly relevant as this considers both the social and technical aspects of technology implementation. The theory for this project is chosen inductively as the insights from the empirical data have led to the choice of theory. The following theories are chosen for this study: *Technology Acceptance Model 2* (TAM2), *Self-efficacy*, and *Digital literacy*. These theories incorporate elements of both social and technical dimensions.

TAM2

The *Technology acceptance model* is developed by Fred Davis in 1986 and focuses on the concepts *Perceived usefulness* and *Perceived ease of use*. The *Perceived usefulness* is defined as *"The degree to which a person believes that using a particular system would enhance their job performance."* (Davis and Venkatesh, 2000, p. 187), while the *Perceived Ease of Use* is defined as *"The degree to which a person believes that using a particular system would be free of effort"* (Davis and Venkatesh, 2000, p. 187). To gain an understanding on how healthcare professionals perceive the implementation of Teton.ai, the extended version of TAM, *the technology acceptance model 2*, is applied. This model builds on the original Technology acceptance model and ads factors impacting the individual's perceived usefulness and perceived ease of use. These factors are the *Subjective norm, Image, Job relevance* and *Result demonstrability*. *The Subjective Norm*, refers to, how the other people who are important to the user form their decision to use the technology affects the individual's adoption of the technology. *The Image* is to which degree the technology is perceived by the induvial to enhance status for example within a social group or work environment. *The Job relevance* is about how the technology is relevant to the individuals job. The *output quality* is if the individuals believes that the technology performs its tasks well. The *Result demonstrability* is about the benefits from applying and integrating the technology and if these results from a something that the individual can see (Venkatesh and Davis, 2000). In the following figure the relations between these terms are visualized showing how the *subjective norm*, *Image*, *Job relevance*, *Output quality, result demonstrability* and *Perceived ease of use* affects the *Perceived usefulness*.

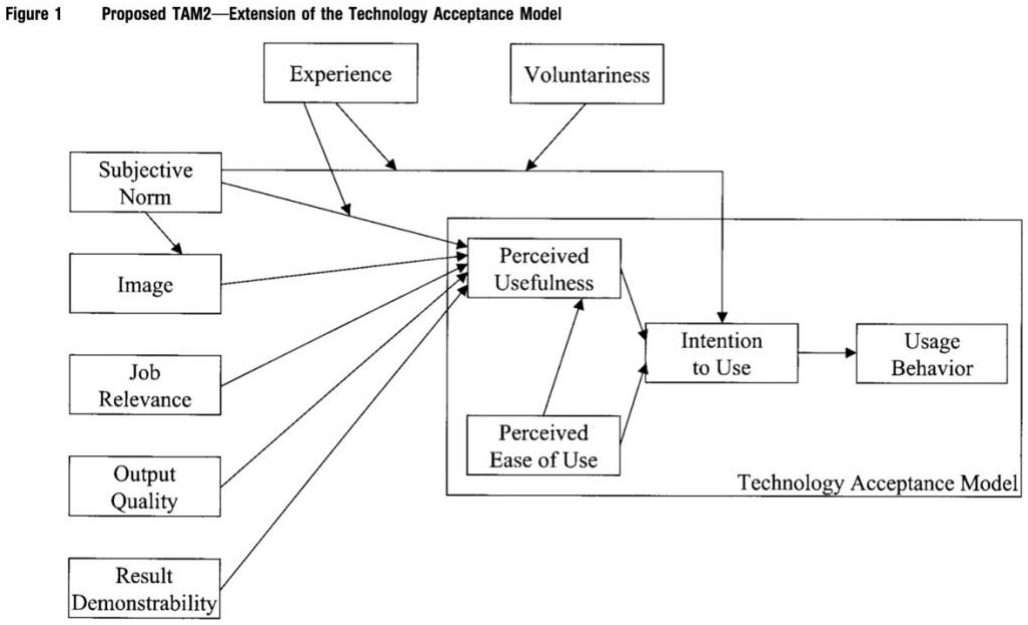


Figure 12 (Venkatesh and Davis, 2000, p. 188)

The adoption of technology in healthcare affect patientcare, healthcare professionals' tasks and work environment by redefining and challenge the traditional practices in healthcare (Sundhedsmonitor, 2024b). There is a need to ensure that technology in healthcare contribute positively to the healthcare professionals work and the quality of patientcare. This underlines the need for frameworks like the *Technology acceptance model 2*, to assess and predict how healthcare professionals accept and interact with the implementation of these new technologies. The *Technology acceptance model 2*(Venkatesh and Davis, 2000) is applied as a part of the theoretical framework of this study to analyze the empirical data. This theory is socio technical as it examines the technical and the social perception of a technology. The *Technology acceptance model 2*, allows an investigation of the implementation of Teton.ai, implying the *perceived usefulness* of Teton.ai. and how it is integrated into daily routines indicating the *perceived ease of use*. This provides a systematically understanding of the factors influencing the healthcare professionals' acceptance of Teton ai.

While TAM2 provides an understanding of the rationales behind technology adoption, when it comes to the acceptance of technology. Self-efficacy theory can add extra a layer of understating the motivation and factors that influence the healthcare professional's technology acceptance presented in the following section.

Self-efficacy

The concept, *Self-efficacy*, by Albert Bandura (Bandura, 2010), was selected to add to the theoretical lens to add on emphasis on the individual's belief in their capability to perform specific tasks, in this case adopting to new digital technologies. Following the concept of *self-efficacy*, the belief in own competencies significantly impacts individuals' motivation and actions. The theory underscores the importance of personal confidence in one's abilities, which correlates with how healthcare professionals perceive and adopt new technologies. This theory is socio technical as it involves personal factors such as the belief in own capabilities and their interaction with the environment, including the availability of technological tools. Albert Bandura's theory of *Self-efficacy* is central to understand in the role of individuals beliefs in technology adoption. *Self-efficacy* refers to an individual's belief in their capability to execute behaviors necessary to produce specific performances. It influences how people think, feel, motivate themselves, and act (Bandura, 2010). The concept of *Self-efficacy* includes the following components, *Mastery experiences, Vicarious experiences, Social persuasion, Physiological and Emotional states. Mastery Experiences* is about how successes can help build a robust belief in an individual's *Self-efficacy* and if the individual experience is lacking it can challenge *Self-efficacy*. The *Vicarious experiences* is about how it can strengthen an individual's *self-efficacy* when observing others successfully completing a task motivating them to do the same. *Social persuasion* is about how encouragement from others can increase an individual's *self-efficacy* while negative feedback from others can decrease it. The concept of *Physiological and emotional states* refers to how for example stress can negatively impact an individual's *Self-efficacy* and opposite positive emotions can enhance it (Bandura, 2010).

In the context of this study the concept of *Self-efficacy* provides insights into how healthcare professionals' confidence in adopting new technologies can affect their willingness and ability to adopt new technologies like Teton.ai. Both the *Technology acceptance model 2* and *Self-efficacy* helps uncover factors, that either enhance or challenge *Self-efficacy and Technology acceptance.*

Digital literacy

Digital literacy, specifically within the context of healthcare has a critical role in the effective adoption of digital technologies. Helen Monkman and Andre W. Kushniruk provide an assessment of *Digital health literacy*, emphasizing its importance in the design, implementation, and success of healthcare technologies. *Digital health literacy* is defined as *"the ability of individuals to acquire, process, communicate, and understand health information and services, enabling them to make effective health decisions and improve health outcomes using digital information and technologies"* (Monkman, 2024). This concept is an extension of health literacy, which involves the capacity to access, understand, and apply health information across various contexts to promote and maintain digital literacy. *Digital health literacy* is particularly relevant as the digital health resources and applications increasingly continues to grow which rises the need for competencies in using these technologies effectively. The relationship between Digital Health Literacy and Usability is highlighted by Monkman and Kushniruk to be the essential link when it comes to health information systems. They propose that for Health information systems to be effective, there must be a balance between the users' Digital Health Literacy skills and the demands that these systems place on those skills (Monkman and Kushniruk, 2015). This concept is socio technical as it involves the technical ability to use digital tools and the social context in which these tools are used including the need for education and training of healthcare professionals competencies. If a digital technology demands a high level of *Digital health literacy* that challenges the user's capabilities, the adoption will possibly be unsuccessful. This mismatch can lead to healthcare professionals who can not to adopt to a technology resulting in lower work efficiency and patientcare (Monkman and Kushniruk, 2015).

Digital health literacy is a factor influencing adoption and use of health information systems. By enhancing digital literacy skills and designing systems that are accessible and easy to use, healthcare institutions can support their staff in more effectively integrating new technologies into practical settings. Following this theory by Monkman and Kushniruk offers valuable guidance for creating a more inclusive and effective digital health environment, working towards that healthcare professionals can better adopt to new technology and herby improve patient care.

Theoretical lens

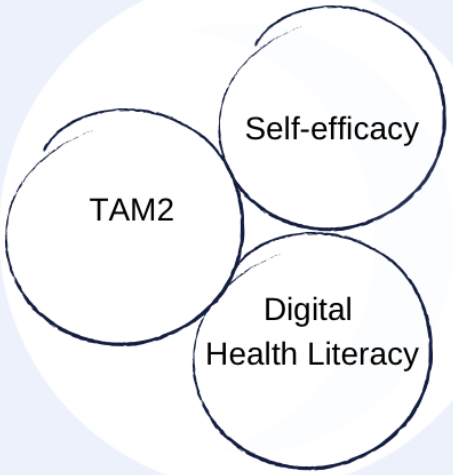


Figure 13 Illustration of the theoretical lens

By integrating *TAM 2*, *Self-efficacy*, and *Digital health literacy*, this thesis provides a widespread framework to analyze the factors influencing the adoption of Technology in hospital settings. *TAM2* offers insights into the *Perceived usefulness* and *Perceived ease of use* of the technology and factors influencing these. While *Self-efficacy* theory highlights the importance of individuals confidence and the need for supportive environments. *Digital health literacy* underscores the critical role of manageable design and the necessity of preparing healthcare professionals with the skills needed to effectively use new technologies. The choice of theory is chosen inductively from the empirical findings i.e., interviews with health stakeholders, ethnographic fieldwork at the Neurological Ward in Nordsjællands Hospital and the survey. The theory allows for a nuanced understanding of the challenges and opportunities associated with technology adoption in healthcare, providing valuable insights into how healthcare professionals is integrating innovative technologies into their practice. Each of these theories provides a framework to answer the research questions in this study which will be unfold in the following section.

Analysis

In the following section the empirical data is presented through a thematic analysis, highlighting the themes that emerged from the informants' experiences and perspectives. The patterns and findings are providing as understanding of the factors influencing technology adoption. To provide a deeper and more nuanced understanding of the empirical data, the theoretical lens is applied i.e., *The Technology Acceptance Model 2*, the concept of *Self-efficacy* and *Digital health* literacy. By integrating these theories to the empirical findings, the factors that influence the adoption and integration of new technologies in healthcare is analyzed and unfold.

Insights from interviews with health stakeholders

This section presents perspectives from stakeholders involved in different aspects of technology implementation presented through a thematic analysis of the themes of the conducted interviews. When quotes are presented from the informants i.e., Health Stakeholders they are referred to as Health stakeholder (HS) followed by the organization they are working at.

Efficiency is prioritized

The importance of effectiveness when evaluating new technologies is high on the priority list when new technologies are implemented in healthcare. *HS* from *The Danish health technology council* outline this prioritization in the following quote.

> *"We look at the effect, that is, the expected effect. So, if the technology has a notable effect, it is prioritized higher on our list."* (Pers. Comm., HS Danish health technology council)

HS from *Research and Innovation of Rigshospitalet* emphasizes the need for technologies in healthcare to be efficient and cost saving in the quote below.

> *"So, to take something new into use, it has to save recourses, it has to be efficient, and of course, it's a boring way to look at innovation, but it is the reality, in the Danish healthcare system, and internationally as well."* (Pers. comm., HS1 Research, and Innovation of Rigshospitalet)

HS2 from *Research and Innovation of Rigshospitalet* highlights this trend in decision-making when it comes to new innovative initiatives outlining that projects that are proven to be time-efficient often are prioritized.

"Labor-saving technology is very high on the agenda. Perhaps even higher than quality, or what you might say. It's not that it should be set up as if it's necessarily a contradiction, but I believe it's easier to get funding for something where you can demonstrate that it saves time, rather than something that provides a better experience or comfort." (Pers. comm., HS 2 Research and Innovation of Rigshospitalet)

High quality standards can prolong the process of implementation

The need for solid evidence and validation is needed for healthcare technologies to meet the high quality standards in healthcare. In the following quote *HS* from *The Danish health technology council* compares the quality evaluation of pharmaceuticals to the quality evaluation of technology.

"What we almost always encounter is that, unlike pharmaceuticals, there are rarely good, solid clinical studies when it comes to technology. So, we often find it difficult to find, or the companies themselves find it difficult to find, what we call solid evidence when it comes to technology in healthcare" (Pers. Comm., HS Danish health technology council)

The lack of solid evidence when it comes to technology in healthcare can make it challenging to provide the necessary proof of efficacy. In the following quotes *HS* from *The Danish health technology council* elaborates on this topic and how the health technology industry should adopt to standards evaluations similar to those in the pharmaceutical industry, drawing a parallel to the quality insurance of medicine.

"The entire medical equipment industry is now starting a journey that the pharmaceutical industry has been on for many years. That one must be able to document the effect of the product being put to the market. Nowadays, no one would take a pill without it being thoroughly examined. So, we shouldn't allow ourselves to have something operated into our body or be monitored with a technology if we do not know how is working" (Pers. Comm., HS Danish health technology council)

However, *HS* from *Center for IT and Medico technology* (CIMT) acknowledges that high quality standards are needed in healthcare while emphasizing that these high quality standards can be a significant hurdle slowing the process.

"Since it's healthcare and we want to be sure it works, it usually takes years before something is implemented. " (Pers.Comm., HS CIMT)

HS from *CIMT* also underlines that they continue to improve already implemented technologies like the E-health platform, often based on initiatives from healthcare professionals to keep up with quality standards.

"For example, something like the Health Platform, where functionality is constantly being developed. You could say, it develops with us who help build it. But often it's at the instigation of the clinicians who say, oh, I would like to register this to ensure a certain quality of documentation" (Pers.Comm., HS CIMT)

Prestige vs practicality

Sometimes technologies receive traction and attention not only based on its efficiency as the prestige associated with the implementation can have a political or other interests. In the following quotes *HS1* from *Research and Innovation of Rigshospitalet*, reflects a critical challenge on how political motivations or funding restrictions can affect the desire for innovative projects that may have a high visibility. Outlining that the best clinical choice may not always align with other interests and considerations.

"Well, we also have this fantastic thing with these medical helicopters, which many of our clinicians are really happy about. But there is no evidence that supports better patientcare. However, it's a great thing for a politician to be able to say they introduced a helicopter. So, there are always different aspects to these things. What exactly makes one thing chosen over another? And sometimes it's the prestige of being able to introduce it. Just that." (Pers.Comm., HS 1 Research, and Innovation of Rigshospitalet)

Barriers to successful implementation and scalability

This theme evolves around how there can be barriers in the process of implementing technology in healthcare. In the quote below *HS2* from *Research and Innovation of Rigshospitalet* explains an example where the integration of a technology was a challenge.

"*There's a difference between whether something is core infrastructure or an extra service. There was a ward that tried using these sushi robots to move around. It wasn't a success because it wasn't integrated into the daily work tasks. The nurses were clearly the ones who were supposed to use the machine for something, but this didn't happen"* (Pers.Comm., HS 2 Research, and Innovation of Rigshospitalet)

This quote above can also be added to the of the previous theme *Prestige vs practicality* as the practicality of the technology referred to as *Sushi robots* did not ad anything to the nurse's daily work. *HS* from *CIMT* explains how the full potential of research projects sometimes are not reached due to economic challenges, problematic scalability, and a lack of real-world testing.

"There are many research projects the unfortunate thing is that not very many of these research projects actually end up being implemented afterwards. There can be several reasons for this. One of the major challenges is often that, although research projects show good results, they lack scalability and economic sustainability, which are necessary for broad implementation in a healthcare system. Moreover, the transition from research to practice is complicated by the fact that many research projects are designed under ideal conditions that do not necessarily account for the complex and often chaotic realities in healthcare environments. This means that what works in a controlled environment cannot always be replicated in the real world without significant adaptations" - (Pers. Comm., CIMT)

Creating a culture of innovation and balancing innovation with practicality

Balancing practical needs while fostering a culture of innovation in healthcare seems to be difficult but essential for successful implementation of technology. *HS2* from *Research and Innovation of Rigshospitalet* outlines that this requires an environment where the Unit managers of at the hospital Wards ensure that healthcare professionals have the commences for this task:

"Engaging innovation from the healthcare professionals requires creating psychological safety, creating a work environment where people dare to come up with good ideas. Where it is natural to expect each other to come up with good ideas. And I see that very much as the foremost task of a frontline leader, to create a work environment where it is natural to talk about this and encourage in some critical self-reflection" (Pers. Comm., HS 2 from Research, and Innovation of Rigshospitalet

HS from *Copenhagen Health Innovation* (CHI), stresses that to ensure new innovational and technological innovations to be successful there is a need to ensure relevance and scalability by combining a bottom-up and top-down perspective.

"I simply do not think we will get very far if we do not ensure that there is at least both bottom-up, as we work a lot in CHI, and then I think for things to really take off, we also have to say something about scaling and all that. If the solution has to live beyond just locally, then I believe there must also be some form of top-down, and when I say top-down, it's not to say that one should go out and decide that now we have to do this. It is more about the strategic focus, and it can be something like saying, well, if I don't argue that it is more for less, that is, this time-saving work, well then, we would like to look at your projects, that's the way I mean it" (Pers. Comm., CHI)

Furthermore, the health care professional's knowledge is considered ad crucial when it comes impactful and practical ideas explained by *HS* from *CIMT* in the quote below:

" If the healthcare professionals had a better flair on technology, I think it could make implementation process better, but I don't think technological knowledge is their superpower. Their superpower is their deep professional understanding of patientcare. That's where all the good ideas

come from. We can't sit in CIMT and come up with good ideas. We can have some umbrella good ideas and we can hear about some good cases. But really - all the good ideas come from the clinicians. And that's why the hospitals. Keep sending so many requests our way. Because there are some clinicians who say why should we keep having this fixed process for something. It's ridiculous. And that's the thing. Well, why is it like that? Well, it's just been one way." - (Pers.Comm. HS CIMT)

Contrary, *HS 1from Research and Innovation of Rigshospitalet* emphasizes that sometimes developers sometimes can see different solutions than the healthcare professionals are able to think off. In the following quote It is explained by the example of wanting a faster horse:

"There is also this famous quote that if a person riding a horse-drawn carriage asks for a faster horse, someone from the outside, a developer, might see that you need to think in a completely different way, for example, inventing a car. So, this doesn't mean that as a developer, you should go back and make a faster horse. Maybe you shouldn't think so much about horses, but about something faster, something mechanical like a car, right?"(Pers.Comm., HS 1from Research and Innovation of Rigshospitalet

To address the challenges in making innovative and technological solutions in health care more practical and aligned the clinicians needs HS from CIMT comes with an idea for a solution by making a stronger collaboration between the regions so the regions can learn from each other's successful and unsuccessful implementations of technologies. Herby more technology could be bought on the same bill which can help economically but because the regions budgets are so separated this is difficult. Additionally, he suggests making a showroom with approved technologies that healthcare professionals can visit and try applying the to know if it is something that would be relevant to test at their specialized.

" We have set up a cross-regional group to evaluate if our resources can bring benefits and momentum regarding innovative and technological initiatives. If all five regions could create a radar and collaborate, we could leverage each region's strengths. And by purchasing expensive equipment like full-body scanners on the same bill we could save millions. I would say from a human perspective. I would really like us to have exhibition center. A test center. An experience

center. An innovation lab. A corporate garage where clinicians can see and choose approved solutions. It would be like a supermarket for technology. Because it is also very different what is needed for different hospital wards" (Pers.Comm., HS CIMT).

HS from CHI reflects on the infrastructure of innovation and that innovative initiatives happen from dedicated individuals who make it happen although the infrastructures do not fully allow it.

"*I simply believe that you also have to let innovation live as it does, I do not necessarily think you can put complete structure on how these things happen because I have experienced for many years that innovation does not happen because of everything else in the region but in spite of everything else in the region" (*Pers.Comm., HS CHI)

HS from *The Danish health technology council* suggests a flexible standardized evaluation tool to be applied before any new technology it is chosen to be implemented at hospitals, as expressed in the following quote:

"What I hope for the most is that all purchases made in hospitals could be preceded by a flexible but standardized kind of evaluation tool. I relay think this kind of imitative could have an impact on technology integration in healthcare. I think that's the direction we could take." (Pers.Comm., HS Danish health technology council)

These interviews with stakeholders provide an understanding of some factors that can affect the implementation of technology in a hospital setting. These factors can be seen as a frame around the technology adoption that can have an impact on the implementation of technology in healthcare As these health stakeholders are not the direct users of healthcare technologies the empirical findings from these interviews can add more to the perspectives that influence the conditions and environments where healthcare technology is implemented. In the following section technology implementation in hospitals is presented as a case from the viewpoint of healthcare professionals.

Insights from studying the Teton.ai implementation at the Neurological Ward

In this section the findings from ethnographic fieldwork conducted at the Neurological Ward in Nordsjællands Hospital, are to be presented. The findings unfold how the healthcare professionals experience and interact with the Teton.ai system. In the following sections the thematized themes are presented along with quotes from the healthcare professionals.

Work shortages and heavy workload

During the first day where the fieldwork was conducted, it was evident that the healthcare professionals were experiencing a high volume of work. The quote below underlines that there were many patients and not many healthcare professionals the current day:

"When I arrived, I was informed that it was a particularly busy Monday. Many acute patients had been admitted during the weekend and one of the substitute nurses had not shown up, so they were lacking staff" (Appendix, Fieldnotes and observations)

Additionally, challenges were complicating the healthcare professionals work as there were some patients who needed extra attention and some of the staff was multitasking at the nurse office as explained in the following quote.

"A nurse explained that two patients needed extra attention this morning as one patient was severely ill, and another patient had a lack of understanding why he needed to be admitted and wanted to leave the hospital. In the nurse office the pressure on the staff was noticeably by their urge to multitask. One nurse was holding a phone squeezed between her ear and shoulder, discussing a patient's condition with a doctor while documenting on the computer. Another nurse was printing some labels for the patient in critical condition." (Appendix, Fieldnotes and observations)

The fieldwork conducted at the Neurological Ward of Nordsjællands hospital illustrates the challenges such as work shortages and heavy workload healthcare professionals face. These

findings are crucial to unfold in this case to provide an understanding of the context where the Teton.ai system is being implemented.

Teton.ai supports the healthcare professionals in prioritizing patientcare

When asking the healthcare professionals at the Neurological Ward about their experience with the Teton.ai system more of the nurses explains that the system helps them to prioritize and manage patient care more effectively. Especially during nightshifts one of the nurses find Teton.ai helpful and explains that the system helps in compensating for the reduced staff there is during nightshifts.

> *"We have fewer staff on duty at night, so having support from the Teton.ai system helps me to prioritize those patients who need help the most"* (Appendix, Fieldnotes and observations, Sygeplejerske 1)

In the following quote a nurse expresses the appreciation of the Teton.ai systems ability to support in effectively prioritization as the volume of tasks can be overwhelming.

> *"It's his impression that the system adds value because it supports the staff in task prioritization and gives a form of security to the staff in a busy environment; being able to prioritize the right tasks is a huge advantage in a busy work environment"* (Appendix, Fieldnotes and observations Sygeplejerske 2)

A nurse describes how the ability to categorize patients according to the urgency of their needs. This helps in giving patients who are at highest risk immediate attention which one nurse explains to be very valuable bellow:

> *"The triage tool is particularly useful. It assesses and treats patients based on the severity of their conditions, assigning each a color code. This helps me adjust the system's sensitivity, like increasing its responsiveness to minor movements when a patient needs close monitoring, or ensuring it alerts if a patient tries to stand without their walker. This prioritization capability is extremely beneficial" (Appendix,* Fieldnotes and observations*, Sygeplejerske 6)*

Triage is a term used by healthcare professionals referring to the process of quickly examining patients and prioritize the patients who are most critical. It is often visualized by red, yellow, and green colors to have a clear idea for health care professionals to prioritize care interventions.

The implementation of Teton.ai at the Neurological ward has clearly demonstrated its value in supporting the healthcare professionals by enhancing their ability to prioritize and manage patient care more effectively. The healthcare professionals experience Teton.ai supports in maintaining efficiency, in a high-demand healthcare setting.

General technological skills affect the motivation to adopt

The healthcare professionals' level of technological skills seems to influence their ability to adopt to the newly implemented healthcare technology, Teton.ai. In this theme some of the nurses explains how familiarity with technology helps them to be more motivated and adopt new technology in a professional setting. In the quote bellow a nurse reflects on a generational difference in how colleagues have adopted to Teton.ai.

> *"It was clear that those who generally have more experience with technology, especially the younger generations, found it easier to adopt to the system"* (Appendix, Fieldnotes and observations, Sygeplejerske 2)

The following quote further emphasizes the role of generational influence on the adoption towards new technology and how it has affected technological flair growing up in a certain generation.

> *"I'm probably what you'd call a millennial (Born 1980-1995), so even though I'm not one of the youngest, I naturally picked up technology. Once I got help logging in and assigning my patients, I actually found it quite straightforward to understand the system."* (Appendix, Fieldnotes and observations, Sygeplejerske 6)

One of the nurses was very excited about healthcare technology in general and explains how this has been a motivating factor for him to adopt to the Teton.ai system.

"I think Teton is brilliant. But I also love health technology and find it very exciting to keep up with and be part of. He mentions that this this enthusiasm is probably why he quickly incorporated it into his work routine" (Appendix, Fieldnotes and observations, Sygeplejerske 5)

From this theme the motivation to adopt to Teton.ai at the Neurological ward his highly influenced by general knowledge and experience with technology in general. Some mention age as a factor to these skills. Those who have pre-existing skills and interest in technology have an advantage in adopting to new technology such as Teton.ai. This is seemingly a factor that seem to affect the individual health care professional in adopting to the technology.

The domino effect

When asking the healthcare professionals about their experiences with the implementation process of Teton.ai some of the nurses explains that the acceptance and adoption of technology have spread progressively among their collages. In the following quote one nurse explains this progressive adoption of Teton.ai with the figurative language as the domino effect:

"It was interesting to see how older employees began to see the value in the technology as they observed younger colleagues using it effectively. It was as if this created a domino effect—the older staff or those less experienced with technology started to see how their colleagues used it and could see the benefits of adopting it as well. So, there has been a difference in how me and my colleagues has adopted the system." (Appendix , Sygeplejerske 2)

The quick adoption by some of the staff have had a crucial role in starting this domino effect. In the quote below the generational difference in adopting to technology is outlined by one of the nurses.

"I quickly embraced it and began to incorporate it into my workflow, unlike some of the older colleagues who are not as enthusiastic about changes and technology." (Appendix, Fieldnotes and observations, Sygeplejerske 5)

The early adopters seem to act as role models or as someone who can show the practical application of the technology and hereby encourage their colleagues by showing the positive outcomes of applying it.

Quality over time

When I asked some of the nurses if they felt like they saved time after the implementation of Teton.ai they directed the conversation over to talk about quality of care and the work environment as this seemed more important to them than the timesaving aspect. The following quote highlights that the timesaving aspect might be an indirect outcome.

"It's difficult to say if anything is timesaving in a hospital setting, as any available time is always filled with tasks. Even if using Teton.ai or other health technology theoretically saves time, it doesn't necessarily mean the staff feels they have more time; any saved time is simply redirected to previously lower-priority tasks. Although it's challenging to assess if it saves time and labor, the impression is that it adds value by helping staff prioritize tasks and providing a sense of security. In a busy environment, prioritizing the right tasks is a significant advantage, and many colleagues have noted that they less frequently make unnecessary trips to check on patients. From a patient perspective, we've observed fewer falls, enhancing patient safety and slightly reducing the workload, as fewer interventions are needed" (Appendix, Fieldnotes and observations, Sygeplejerske 2)

In the following quote a nurse stresses the importance of seeing technological implementations through the lens of quality improvement rather than efficiency and saving time:

"We should be cautious about focusing solely on whether technology saves time and more on whether it enhances the quality of care and the department overall. It's not just about saving time. While time-saving benefits may emerge indirectly over time, adopting a new system like Teton takes considerable time for the staff. Time savings might be a by-product of its implementation due to fewer falls, improved prioritization, and increased safety. The true time-saving effects might only be visible in the long term and require intense implementation efforts. Although we have invested heavily in the implementation, it still takes time for us to adjust workflows, especially since not

everyone has the same understanding of technology" (Appendix, Fieldnotes and observations Sygeplejerske 5)

In this theme the nurses see a difference in immediate and long-term benefits from implementing the Teton.ai. system at the Neurological ward. Underlining the nurse's viewpoint about how quality should be the first reason to integrate new technologies in healthcare. The management at the Neurological ward also see Teton.ai as a complement rather than a replacement for humans. Employing that the system can add quality but not necessary save staff (Region Hovedstaden 2024).

The extra set of eyes

Especially during nightshifts nurse describes how Teton.ai supports her in having an extra eye on the patients without going to their rooms:

"During night shifts, it's like having an extra set of eyes on the patients" (Appendix, Fieldnotes and observations, Sygeplejerske 1)

In the following quote a specific situation where Teton.ai supported the nurse in preventing a potential patient in falling is giving a clear indication on the system's ability to assist in preventing falls.

"Teton.ai offers a sense of security for me because it allows to respond before a patient potentially falls. Recently, I had a patient at risk of falling due to paralysis on the one side of his body from a stroke. Using the Teton system, I noticed he was trying to get out of bed unassisted. I was able to quickly provide him with his walker, preventing a fall. This system is very preventive especially in a Neurological ward, where many patients are at a high risk of falling due to cognitive challenges" (Appendix, Fieldnotes and observations, Sygeplejerske 3)

To one of the nurses this ability to have an eye on her patients while documenting makes the work environment slightly less stressful.

It also gives me some peace of mind that while I am sitting in the office documenting, I can feel less guilty and anxious about not being physically with my patients knowing that I still can react quickly if something happens" (Appendix, Fieldnotes and observations, Sygeplejerske 4)

This theme makes It clear that the implementation of Teton.ai has an impact both in preventing falls and on the nurse's work environment. This is due to the system's ability to support a more comprehensive prioritization of task by enabling a more focused attention where it is most needed.

Navigating alarms

The system provides an alarm to the nurses who is assigned the specific patient needing assistance. In the following quote one of the nurses find it more relevant to apply the system mostly in specific situations when she has a patient where it is especially relevant, otherwise the alarms can feel disturbing on her workflow.

"She mentions that she doesn't use the system much during daytime hours because there are already many other alarms she explains, it can be disturbing if I'm attending to a patient and I feel the alarm vibrating in my pocket, indicating that another patient might need assistance. However, she adds that she uses it today because she has a patient who try to leave his room every minute. In this situation, the system is very useful. So, how I use the system depends on the circumstances."
(Appendix, Fieldnotes and observations, Sygeplejerske 1)

A significant logistic challenge in having to carry multiple devices is explained as problematic and she suggests the systems to be more integrated in their other devices.

"I think carrying multiple phones is inconvenient, she shows me three different phones. One connects to the E-health platform, one to Teton.ai, and one to their alarm system, where a patient can pull a cord for help. It's burdensome to carry around when we move so much, and there are so many alarms to manage. It would at least be great if everything could be integrated into one phone. (Appendix, Fieldnotes and observations, *Sygeplejerske 3)*

While talking to one of the nurses we were interrupted by an alarm which showed how the alarms can interrupt a certain setting:

"While we were talking, she was interrupted by an alarm and apologized, explaining that she needed to attend to a patient right away." (Appendix, Fieldnotes and observations, Sygeplejerske 4)

One of the nurses appreciates the system's ability to target alarms only to the assigned patients expressed in the quote below:

"Some are talking about alarm fatigue, but I don't see it as a problem because the system is set up to alert only for my assigned patients, which I find relevant when it rings. However, it would obviously be advantageous if the systems could communicate with each other so that everything could be integrated into one device." (Appendix, Fieldnotes and observations, Sygeplejerske 5)

The healthcare professional's ability to navigate the alarms at the Neurological Ward outlines the opportunity for improvement while the alarms also are crucial for the healthcare staff to react in certain scenarios.

Comparing findings

Health stakeholders focus on efficiency and fostering innovation, while healthcare professionals experience the practical benefits and challenges of technology implementation. The healthcare professionals value technology that has direct benefits on the quality of their work tasks and patient care. The health stakeholders prioritize efficiency aiming to try to overcome the heavy workloads faced by the healthcare professionals. The health stakeholders also mention the work environment to highly affect the process of implementing technologies in hospitals which is mentioned as a barrier. One of the health stakeholders mentions that most technologies and research projects are designed under ideal conditions which do not reflect the complex realities of hospital environments making real-world implementation difficult without significant adoptions. The healthcare professionals explain how there are many benefits in applying the Teton.ai system while the theme called *navigating alarms* unravel some challenges. The healthcare professionals also explain how their general technological skills affect how they adopt to the Teton.ai system. One health stakeholder expresses that better technological skills among healthcare professionals could have a positive effect on the implementations process but underlines that the health professionals have other more important competencies. Regarding quality standards health stakeholders recognize that high quality standards are important but can prolong the implementation while the healthcare professionals primary focus on quality when it comes to healthcare technology rather than the time saving aspect. The themes are visualized in the figure below:

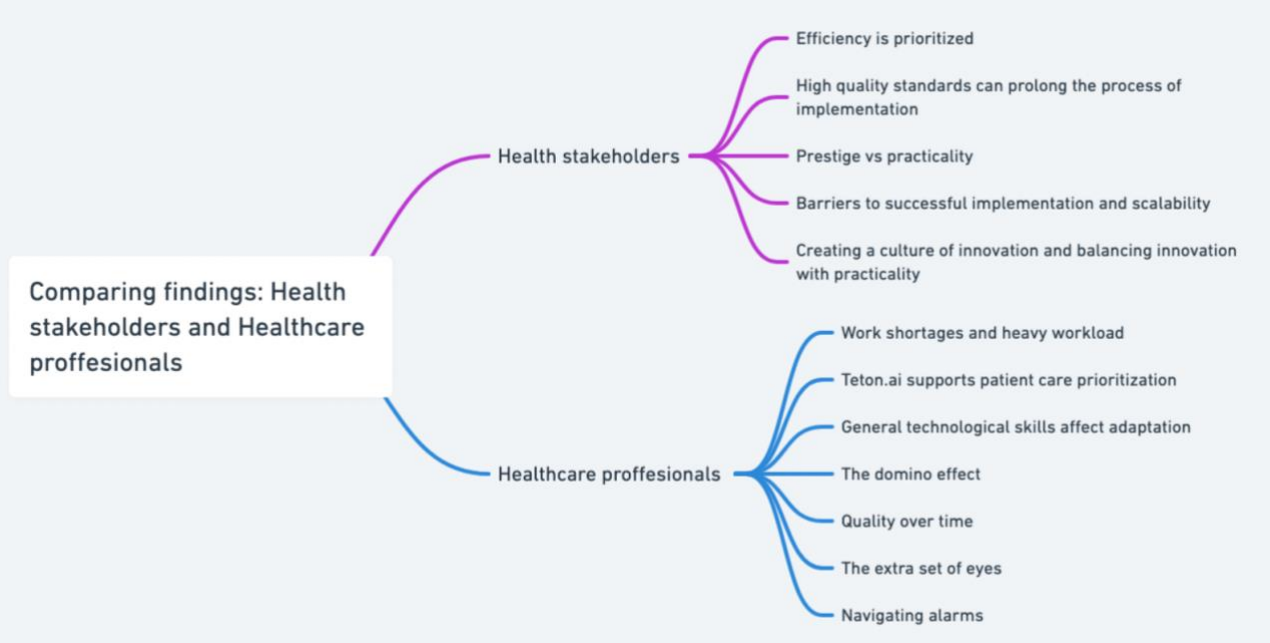


Figure 14 Comparing findings

The findings from the thematic analysis of the empirical data from health stakeholders and healthcare professionals are added to the theoretical lens to gain a deeper understanding of the factors influencing technology adoption in hospitals.

The Technology Acceptance model 2

The technology acceptance model is applied to get a deeper understanding of the factors that affect the implementation and acceptance of new technologies such as Teton.ai. The healthcare professionals are more directly experiencing the implementation of technology while the health stakeholder's express organization structures that indirectly can affect the *Perceived usefulness* and *Perceived ease of use* is applied.

The perceived usefulness related to whether the healthcare professionals believe that using a certain technology can improve their work performance. Some of the nurses explained that *Teton.ai supports the healthcare professionals in prioritizing*. Especially during understaffed and busy days the system seems to have a positive impact on their work performance and environment as it helped them prioritize. The theme *Work shortage and heavy workload* underlines the need for a system that can have a positive impact on work performance by assisting the healthcare professionals in patient prioritization and daily tasks. The work environment is also mentioned by the health stakeholders to have significant impact on the implementation process in the theme *Barriers to successful implementation and scalability***.** The theme**,** *Quality vs. time* theme is about the healthcare professionals view on the reasoning behind implementing technology in healthcare should mainly be for quality improvement. Here they also explain how the system improve patientcare by preventing patient falls. In the theme *High quality standards can prolong the process of* implementation the health stakeholders recognize that high standards are crucial but note that they can prolong the implementation process. The Teton.ai. system provides the healthcare professionals with the *extra set of eyes* as they can monitor the patients although not being present in the room and manage patientcare more effectively. This aligns with the health stakeholder's emphasis in prioritizing efficient technology ad expressed in the theme *Efficiency over quality*.

The concept *Perceived ease of use* relates to whether the healthcare professionals find the adoption of technology free from effort. The theme, *General Technological skills affect the motivation to*

adopt highlights how is expressed as a factor influencing whether the healthcare professionals find it easy to adopt to the Teton.ai system depending on the individual healthcare professionals' technological skills. In the theme *Creating a culture of innovation and balancing innovation with practicality* one of the health stakeholders expressed that the level of technological skills might have a positive effect while adding that their *"Superpower"* is in patient treatment and care (Pers.Comm., HS CIMT). *The domino effect* is about how healthcare professionals with less technological skills seem to be impacted by their collages with a higher flair towards technology. This underlines that the level of technological skills impacts the *perceived ease of use* as the healthcare professionals who learn from their colleagues with a higher level of technological skills helping them towards finding the adoption free of effort. Seeing their colleagues effectively apply Teton.ai and how it can have a positive impact on their daily work and patientcare, increases the health care professionals who have less technological flair, perceived ease of use. The theme Navigating alarms is about how some of the healthcare professionals find the alarms stressful while some appreciates the system's ability to only make an alarm to the healthcare professionals assigned patients. One nurse mentions that she has to carry many devices despite from Teton.ai and that is inconvenient. This is something that affect the *perceived ease of use* keeping the device on her is not free of effort, but inconvenient.

Many of the themes from the empirical findings are somehow connected to either the *perceived usefulness* or *perceived ease of use.* Following the Technology acceptance model 2's framework the perceived usefulness is affected by further external factors which are the *subjective norm, voluntariness, image, job relevance, output quality, result demonstrability* and *experience.*

The subjective norm refers to the influence of individuals who are important to the individual for example colleagues or the management affect the acceptance of the technology. In the case of Teton.ai. the healthcare professionals are affected by their collages when it comes to the adoption of Teton.ai as expressed in the theme *The domino effect*. The need for this is also expressed in the theme *Creating a culture of innovation and balancing innovation with practicality*, where it is expressed to be the foremost task of frontline leaders at the hospital wards to create a work environment where it is natural to talk about innovation solutions (Pers.Comm., HS2 Research and innovation of Rigshospitalet). This correlates with the concept the *subjective norm* as colleagues and management as it is expressed that they affect the implementation of technology both in the

case of Teton.ai and on a more structural level as frontline leaders are referred to. The concept, *Experience* is in line with this as experience affects the healthcare professional's adoption to Teton.ai. The theme *General technological skills affect adoption* expresses how experience with technology in general influence the integration of Teton.ai.

If the healthcare professional feel like the technology enhances their professional *image* this can positively influence the perception and willingness to adopt. The theme *Quality vs. time* has some elements that aligns with the *image.* The healthcare professionals find the need for the technology to assist them in at delivering a higher quality of care to their patients and better patient safety as this is something that can enhance their professionals' image. The concept *job relevance* referring to whether the technology is relevant for their job, *quality output* and the concept *result demonstrability* about how demonstrable the results of using Teto.ai. is. This is expressed in the themes *Teton.ai supports patient care prioritization* and *the extra set of eyes and Quality over time*. Here the healthcare professionals express that the Teton.ai assist them in daily tasks including prioritizing patients and improve patient safety. The concept *voluntariness* reflects if the use of the technology is perceived to be mandatory or voluntary. This is expressed in as the healthcare professionals outline that it is different how they and their colleagues apply the system. Some find it most beneficial at night shifts while others use it more integrating all the time. (Appendix, Fieldnotes and observations). This reveals that it might not be strictly outlined whether the healthcare professionals must apply the system. However, is should be considered that Teton.ai is newly implemented and other factors such as workload and technological skills for example also can be affecting this. This might be on purpose as the concept of *Voluntariness* enfolds that it is voluntary to adopt it is found that there might be a lower resistance towards adopting the system. While if it is perceived as mandatory to adopt this can result in frustration for example towards the management choosing to implement the system (Venkatesh and Davis, 2000).

The Technology acceptance model 2 helps unfold a deeper understanding of how different concepts and the theme clearly can affect the acceptance and adoption of new technologies such as Teton.ai. The nurses express practical knowledge while the stakeholders more explicit affects technology adoption on a more structural level. This study is not an evaluation of whether Teton.ai. is accepted by the healthcare professionals but rather an investigation of factors influencing the implementation

of technology in hospitals. Therefore, Self-efficacy is added to the theoretical lens to dive deeper in to understanding these factors.

Self -efficacy

Self-efficacy is influencing "how people think, feel, motivate themselves, and act." (Bandura , 2010). The following concepts are related to the findings below: *Mastery experiences, Vicarious experiences, Social persuasion and physiological* and *emotional states.*

The *mastery experience* is directly related to the theme, *General technological skills affect the motivation to adopt,* about how the healthcare professionals' general level of technological skills affect the technological adoption. The healthcare professionals who have a higher level of technological skills seems to be more motivated to adopt to Teton.ai and experiences initial success with the system. This can be seen as a *Mastery experience*, enhancing the healthcare professionals self-efficacy and resulting in feeling more motivated a likely to embrace and adopt new healthcare technologies such as Teton.ai. On the opposite healthcare professionals who does not have that high general technical skills and experience can consequently feel less motivated to adopt to Teton.ai. The healthcare professionals' level of technological skills is hereby affecting their level of mastery experience i.e. their self-efficacy. The theme, *The domino effect* is indirectly affecting the mastery experience. The theme enfolds. how the healthcare professionals having a higher level of technological flair starts a domino effect as the less technological faired healthcare professionals learn from them affecting their adoption to the new technology. Hereby the healthcare professional's mastery experience i.e., *General technological skills affect* can act as a catalyst starting a *domino effect* resulting in the adoption increasingly can be improved among the healthcare professionals.

Vicarious Experiences occur when individuals observe others perform a behavior and see the outcomes of that behavior, affecting the individuals' capabilities to perform a creatin action. The theme, *The domino effect* is directly linked to the concept of *Vicarious Experiences*. The healthcare professionals with limited technological skills in general are more motivated to adopt the technology when observing others successfully adopt to the Teton.ai. system.

The *vicarious experience* influences the healthcare professional's *self-efficacy* particularly the ones who is lacking technological skills when seeing their colleagues adopt successfully to Teton.ai. giving a higher level of *self-efficacy* a belief mastering this adoption.

Social Persuasion refers to verbal and non-verbal feedback about an individual's capability to perform a certain task. In relation to the case this is not something that explicitly is found. Although it could be something that could make *the domino effect* even more effectful. For example, healthcare professionals can share their experience with Teton.ai affecting their colleagues' self-efficacy. This can be affected either negatively or positively but in reference to the implementation of Teton.ai many of the healthcare professionals expressed that the system had some positive effects on their work. If some of those were to share their positive experiences with Teton.ai. this could encourage other healthcare professionals to adopt to the system.

The concept of *Physiological and emotional States* is referring to the internal feelings and physical reactions that individuals experience, which influence their level of self-efficacy. This concept is connecting to the theme, *Work shortages and heavy workload* as this can affect both *the physiological and emotional states* of the healthcare professionals. If the healthcare professionals continuously are exposed to stressful situation where they need to multitask, due to work shortage etc. it can lead to feelings of being emotionally overwhelmed and consequently affect their self-efficacy and their motivation to adopt the Teton.ai. system. Physiological the *Work shortages and heavy workload* can also affect the implementation, as described in the theme where a nurse is multitasking holding a phone while documenting on the computer etc. This is something that affect the healthcare professional's capacity to engage and adopt a new technology such as Teton.ai. The health stakeholders also express that the work environment highly affects the implementation process. In the theme *Barriers to successful implementation and scalability,* a heavy work environment is I expressed to be a significant barrier when it comes to innovation and technology implementation. Following Artur Banduras theory, the healthcare professionals' level of self-efficacy and the above-mentioned themes affect *Cognitive, Motivational and Affective* selection-processes. Herby the healthcare professionals' level of self-efficacy is indirectly a factor influencing technology implementation based on this case.

Despite from the work environment, the theme *General Technological skills affect the motivation to adopt,* and *the domino effect* is seemingly a factor influencing the healthcare professionals level *self-efficacy*. To look deeper into how the technological skills is affecting the implementation the concept Digital literacy is added as the las theory to the theoretical lens.

Digital literacy

The concept of digital literacy has been recognized to be increasingly critical in the design and implementation of health technologies article and digital literacy impacts the usability and implementation of technology in healthcare (Monkman and Kushniruks, 2015). Following Monkman and Kushniruks findings their e-health literacy is fundamental to enhance successful adoption of healthcare technology. By focusing on the alignment between the user's digital literacy and the usability of the technology this theorical framework offers insights on how to improve the implementation of technology in healthcare. The healthcare professional's digital literacy seems to impact the adoption of Teton.ai. Enhancing digital literacy among healthcare professionals aligns with improving the usability and implementation of technologies like Teton.ai, ultimately leading to better integration and patient care. Inspired by H. Monkman & A. W. Kushniruk (2015) figure 16 illustrates how the healthcare professional's digital literacy is connected to and affect the adoption of Teton.ai. This is put in connection to *self-efficacy* and *The technology acceptance model 2,* demonstrated below:

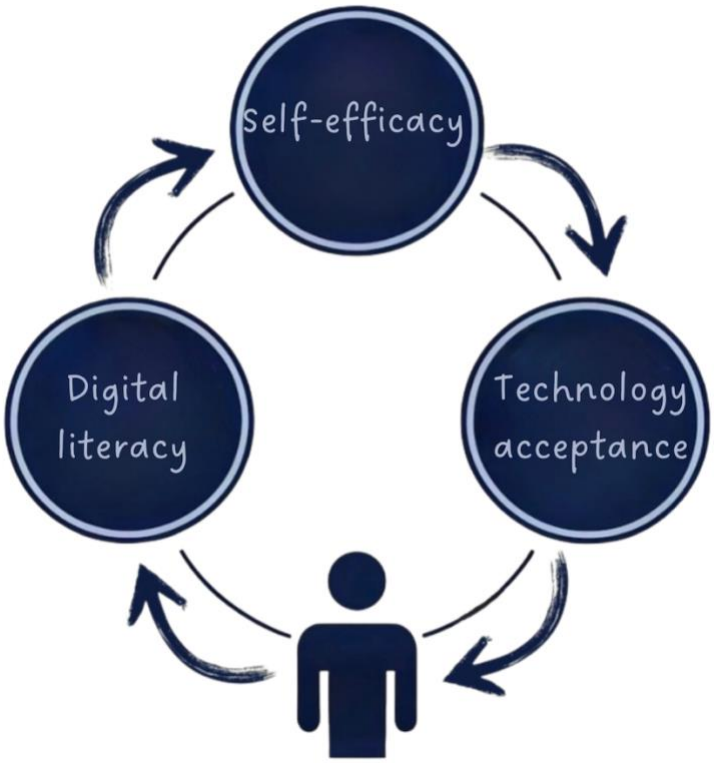


Figure 15 Illustration of the connection between Digital literacy, Self-efficacy and TAM2

The figure above illustrates the connection between *digital literacy, self-efficacy,* and *technology acceptance* among healthcare professionals. The person in the center symbolizes a healthcare professional and the arrows indicate that both *digital literacy* and *self-efficacy* directly influence healthcare professionals' capacity to accept and adopt to new technologies. Healthcare professionals with higher level of *digital literacy* are more likely to feel confident, in adopting digital tools. When healthcare professionals have a higher level of *self-efficacy*, they are more likely to accept and integrate new technologies into their practice. As the *General technological skills affect the motivation to adopt* and *the domino effect* reflect, confidence in using technology lowers resistance towards Teton.ai. and encourages adoption among healthcare professionals. This figure underscores the critical role that digital literacy plays in the integration of technology in healthcare.

By analyzing the empirical data collected through interviews with health stakeholders from the Danish Health Technology Council and Research and innovation of Rigshospitalet, CHI and CIMT and from fieldwork collected at the Neurological Ward in Nordsjællands Hospital through the lens

of *TAM2, Self-efficacy* and *Digital literacy* it becomes evident that the implementation of technology in healthcare is influenced by various factors.

From the interviews with health stakeholders, it is emphasized that the prioritization of efficiency and cost-effectiveness often is placed above quality improvements. This prioritization highlights the necessity of demonstrating significant effects and cost savings to justify new technology implementation. Although the high quality-insurance in healthcare is acknowledged the demanded quality standards required for healthcare technologies, often prolong the implementation process. Stakeholders also mention that political motivations and the prestige associated with certain technologies can overshadow practical considerations consequently leading to a prioritization of high-visibility projects that may not necessarily align with the healthcare professionals needs. Barriers to successful implementation such as scalability issues and integration challenges due to heavy work environments also mentioned by the health stakeholders as a significant challenge in the process of implementing technology in hospitals. The experiences shared by the health stakeholders reveal the difficulties in transitioning research projects into practical scalable solutions within the healthcare system. Moreover, they underline the importance of creating a culture of innovation within healthcare settings as this is crucial for fostering a successful adoption of new technologies. This requires an environment where healthcare professionals feel supported and encouraged to engage with innovative solutions while balancing the practical needs.

The perspectives from the health stakeholders provide valuable insights into the structural conditions and environments where these technologies are deployed, which seemingly will shape the way forward for future technological advancements in healthcare. The case study of Teton.ai's implementation at the Neurological Ward in Nordsjællands Hospital offers a concrete example of these dynamics. The Teton.ai system was found to significantly support healthcare professionals in prioritizing patient care, especially during work shortage and night shifts. Nurses reported that the system provided an *extra set of eyes***,** helping them monitor patients more effectively and prioritize urgent needs, thereby enhancing the overall quality of patient care. The adoption to new technology varied among staff as their level of technological skills affected the implementation. Applying the *Technology Acceptance Model* 2, outlined *the perceived usefulness* and *perceived ease of use* of Teton.ai and how the thematic findings seem to affect the acceptance. The additional concepts of the *Technology Acceptance Model* 2 nuanced the understanding of acceptance further. Including the

concept *Subjective norm* made it clear that colleagues and the management highly affects the *perceived usefulness*. Additionally, those with a higher-level of digital literacy expressed that general technological experience made it easier to adopt to the system, highlighting the importance of *mastery experiences* and *vicarious experiences* in building *self-efficacy*. The nurses with a higher level of *self-efficacy* due to previous successful interactions with technology were more motivated in integrating Teton.ai into their workflows. *The domino effect* observed among staff where early adopters influenced colleagues, underscores the role of *social persuasion* and *vicarious experiences* in enhancing *self-efficacy*.

Digital literacy emerged as a crucial factor in the successful implementation of healthcare technologies. The varying levels of technological skills among healthcare professionals influenced their motivation and ability to adopt to Teton.ai. The concepts underline the connection between digital literacy and usage. Enhancing digital literacy might improve the adoption and integration of new technologies, such as Teton.ai. in hospitals settings. The perspectives of stakeholders, combined with the practical insights gained from the Teton.ai case, provide valuable insights into the conditions and environments where these technologies are implemented. In the next section these findings, challenges and potential solutions will be discussed.

Discussion

Building on the analysis this discussion delves into the challenges and opportunities of technology implementation in hospitals. The prioritization of cost-effectiveness technologies, the influence of political motivations, and the role of digital literacy among healthcare professionals will be discussed. Exploring the case study of Teton.ai's implementation at the Neurological Ward in Nordsjællands Hospital, has revealed insights into the practical dynamics of technology adoption. Hence, the potential benefits and challenges faced when implementing technologies in healthcare settings. This discussion will outline some of the essential factors for successful technology integration and the potential solutions to overcome the barriers identified in this study. The perspectives on healthcare technology adoption and its role in addressing the current healthcare challenges in Denmark will be discussed.

Health stakeholders and healthcare professionals' perspectives on technology implementation

The first research question (a) examines the views of health stakeholders on important factors when implementing technology, while the second research question (b) delves into the experiences of nurses at the Neurological Ward in Nordsjællands Hospital and their adoption of Teton.ai. By outlining these viewpoints, it is aimed to uncover the differing priorities and challenges, to provide an understanding of the complexities involved in healthcare technology implementation.

Research question a: W*hat do healthcare stakeholders see as important factors when implementing digital technology in healthcare?*

In the context of healthcare technology implementation, health stakeholders prioritize efficiency, time saving technologies and initiatives. Their decision process is influenced by a variety of factors, including expected effectiveness and the work environment at Hospitals. For example, HS from the Danish health technology Council emphasizes prioritizing technologies based on their expected effect and cost considerations (Pers.comm., HS Danish health technology Council). HS1 from Research and innovation of Rigshospitalet highlights the necessity for technologies to be resource saving and efficient, driven by the realities of the Danish healthcare system (Pers.Comm., HS1 Research and innovation of Rigshospitalet). This is aligned with the political initiatives about

implementing labor-saving technology to overcome the healthcare challenges as outlined in the problem field section (Indenrigs- og Sundhedsministeriet, 2023a),(Kommunernes Landsforening, 2022),(Danske Regioner, 2022). It is also expressed that political prestige can influence the decisions behind new implementation adoption (Pers.Comm., HS Research and Innovation of Rigshospitalet). HS from CIMT acknowledge that while high quality standards are crucial, they also bring significant hurdles and slow down the implementation of new technologies in hospitals. The focus here is on the systemic implications of technology implementation, balancing the need for thorough validation with the practicalities. The broader impact on the work environment is considered in terms of how well technology integrates with existing work processes and infrastructures. The challenge of scalability is also a significant barrier that affect the broader healthcare system's ability to adopt and integrate new technologies effectively.

Research question b: *How do nurses at the Neurological Ward in Nordsjællands Hospital perceive the adoption of Teton.ai. and what factors influence them in the process of adopting this new digital technology?*

The Nurses at the Neurological Ward in Nordsjællands Hospital focus on the practical, the immediate benefits and challenges of technology implementation grounded in the daily realities of patient care. Nurses appreciate Teton.ai for its ability to help them prioritize patient care, especially during shifts where there is less staff for example during night shifts. They value how the system assists in task prioritization and provides a sense of security by monitoring patients even when they are not physically present. They focus mostly on enhancing the quality of care and improving workflow. Teton.ai's ability to help them categorize patients based on the patients' needs directly supports nurses in managing their workload and ensuring them to prioritize critical patients (Appendix, Fieldnotes and observations). These perspectives highlight the immediate impact of technology in patient care and workflow management. However, there are also challenges, such as *Navigating all the alarms* and the burden of carrying multiple devices. Some of the nurses mention that there are other alarms than the ones form the Teton.ai system, making the alarms difficult to navigate (Pers.Comm., Fieldnotes and observations). This correlates to the concepts of *Alarm Fatigue* which is a term that has emerged after more monitoring systems are implemented in hospitals. This is something that should be addressed as this can have consequences towards patient treatment and highly affect the work environment at hospitals. While the Teton.ai system already

have the possibility to navigate alarms to assigned patients other solutions such as education is suggested as expressed in the following quote.

> *"Educational intervention may be the way to manage nurses' alarm fatigue. The use of medical devices in hospitals is increasing exponentially, and for this reason, alarms are inevitable."*
> (Nyarko BA et al., 2023)

In line with this the theme, *General technological skills affect the motivation to adopt* reveals that the nurses' technological skills affect the implantation of technology in healthcare and seems to be a significant factor in the nurse's technology adoption of Teton.ai.

The contrasts between the perspectives of stakeholders and healthcare professionals on technology implementation is nuanced but are somehow connected. As a result of the Danish healthcare challenges, technologies that help overcome these challenges are prioritized on a meso-level by the health stakeholders and on a macro-level expressed in the political initiatives. Regarding the microlevel, based on the Teton.ai case the nurses does not see technology as a solution to the Danish healthcare challenges but rather as a compliment to deliver a higher level of quality in patient care and prioritizing tasks. They express that it is difficult to say if time is saved with the implementation of Teton.ai, as the time always will be used on other deprioritized tasks. A nurse mentions that maybe after a long implementation process it could result in saving some time, but for this to happen there needs to be put a lot of time and resources into this implementation process (Pers.Comm., Fieldnotes and observations). If we follow this case the initiatives from a meso-level and macro-level about overcoming the healthcare challenges including work shortage with the implementation of technology might not be achieved if there is not enough focus on the implementation process. Additionally, based on this case healthcare professionals' digital skills and the work environment seems to be something that affect the implementation and adoption of digital technologies in hospitals.

How to unlock the potential of successful technology implementation?

The findings from the survey about healthcare professionals view on technology in healthcare revealed that most of the respondents rated the involvement of healthcare professionals in technology implementation to be "very important" (82,35%). When they were asked on how to be included when it comes to the integration of technology in healthcare more of them suggested involvement in the development, decision process, and training. Furthermore, some of the expressed challenges was a lack of training (64,71 %), resistance to change (64,71%), technical problems (52,94 %), and insufficient time to adopt (73,53 %) (Appendix, Survey).

The article referred to in the State-of-the-art section *"Barriers and facilitators to utilizing digital health technologies by health-care professionals"* (Borges do Nascimento et al., 2023), is review of 108 articles in the topic of barriers and facilitators for healthcare professionals in the integration of healthcare technologies. In the following quote the findings revealed the barriers and potential solutions:

> *" findings showed that infrastructure and technical issues, psychological barriers, and workload-related concerns are relevant barriers to comprehensively and holistically adopting digital health technologies by Healthcare Professionals. Conversely, deploying training, evaluating Healthcare professionals' perception of usefulness and willingness to use, and multi-stakeholders' incentives are vital enablers to enhance the Healthcare professionals' adoption of digital interventions."*
> *(Borges do Nascimento, I.J. et al., 2023)*

These findings correlate with the findings of this study, especially the workload related barriers are in line with the themes *Barriers affects implementation and scalability* and *work shortage and heavy workload*. The facilitator in deploying training and evaluating for the healthcare professional's adoption correlates with theme, *General technological skills affect the adoption of Teton.ai* as improving these skills is found to be a facilitator in the process of integrating technology in healthcare. From this case *Digital literacy* seems to improve *self-efficacy* among healthcare professionals being critical factors for healthcare professionals to accept and adopt to The Teton.ai. system. Healthcare professionals with a general higher technological skill, found it easier to integrate Teton.ai. into their workflow and adopted quicklier to the technology. Even more

noticeable the healthcare professionals who estimated that they have good *general technological skills* had an important role in starting the *domino effect* among their colleagues who had less technological flair.

The World Health Organization (WHO) have made a *"Regional Digital Health Action Plan for the WHO European Region 2023–2030",* which addresses focus on strengthening digital literacy skills in the general population particularly the health workforce to improve the use of digital health services (World health organization, 2022). The article *"Educating the nurses of 2025: Technology trends of the next decade"* outlines how technological literacy among nurses is essential for the future healthcare. In the article the crucial role of technological literacy for nurses in adopting to the rapidly evolving technology in healthcare through ongoing education is outlined:

"Student nurses, and those already in practice, should be offered ongoing educational opportunities to enhance a wide spectrum of professional informatics skills." (Risling, T. 2017).

Furthermore, age might be a significant factor when it comes to the healthcare professionals' level of general technological skills. Relating this to the case it was expressed that healthcare professionals who grew up with digital technologies adopted more efficient and quickly to the Teton.ai system. In the research article *"Sociodemographic determinants of digital health literacy: A systematic review and meta-analysis"* (Estrela et. al., 2023). A review of 36 articles found that age and educational level were some of the factors that affect the level of digital health literacy expressed in the following quote:

"Age had a negative effect on digital health literacy (B = -0.05, 95%CI [-0.06; -0.04]), particularly among older adults, whereas sex appeared to have no statistically significant influence among the included studies (B = - 0.17, 95%CI [-0.64; 0.30]). Educational level, higher income, and social support also appeared to have a positive influence on digital health literacy." (Estrela et al, 2023)

By addressing this generational indifference and seeing it as a factor in technology adoption among healthcare professionals it can be relevant to discuss if this problem will solve itself. The overall

technological literacy among healthcare professionals may naturally increase over time as more individuals growing up with new technology will enter the healthcare workforce. However, it might not be enough to rely on this generational shift alone to solve the problem of technological adoption in healthcare, which is leading over to the question of responsibility of successful technology implementation in healthcare.

By only relying on this generational shift to overcome the challenges in the implementation of technology in healthcare places the burden on the individual healthcare professionals. As outlined in this project, the healthcare professionals already experience a high workload and a heavy work environment. Putting the responsibility of successful technology adoption on the induvial healthcare professional might not be feasible and might not result in technology helping in overcoming the Danish healthcare challenges. While there are an increase in healthcare professionals reassigning due to the work environment it might neither be practical or fair to put extra responsible on the individual healthcare professional. As the political motivation for implementing labor-saving technology is to overcome work shortage among other challenges it seems important to underline the factors for successful implementation. From this project and the presented research articles the heavy workload and the level of digital literacy is factors that affect the implementation of digital technologies in hospitals. To unlock the full potential of the integration of technology in hospitals it might be beneficial to investigate these factors and how to navigate and improve them to better the implementation of digital technologies in hospitals. If the work environment and healthcare professionals' digital literacy are not recognized as factors affecting technology implementation, the consequence might be negative. Politically, technologies chosen are with the intention to help the workforce, but this might end up having the opposite influence. Due to the emergence of more advanced technologies such as Teton.ai, the need for healthcare professionals to have digital skills might be even more important as expressed in the following quote:

" Technologies are advancing more rapidly than organizations, and professionals can adopt and adapt to them. To help shape AI practices, health care providers must have the skills and abilities to initiate change and shape the future of their discipline and practices" (Wiljer et al. 2021)

While technology and particularly AI is advancing the implementation of technology in healthcare further it is addressed that individual healthcare professionals have a better potential to adopt these

if they receive training in relevant skills. Hence, digital skills and literacy is found to be a factor influencing technology implementation in healthcare. Initiatives improving these skills might help healthcare professionals to navigate the complexities of technology integration leading to more successful implementations of technology in hospitals.

A step towards building a more resilient and responsive healthcare system

The article *"Nurses and Engineers: New health technology requires political action"* discusses the need for political action to accelerate the adoption and implementation of new health technologies in Denmark. It highlights the slow and unequal distribution of new technologies, which currently depend on individuals within the healthcare system. The need for a national strategy to integrate health technologies more effectively to improve patient care and alleviate the workload of healthcare staff is stressed (Sundhedsmonitor, 2024c).

Policymakers play a crucial role in fostering an environment that facilitate successful adoption of healthcare technologies. Initiatives supporting digital literacy could help ensure that the healthcare workforce has the competencies to adopt and herby benefit from the results of technological implementations. This approach not only supports the immediate needs of the healthcare system but also prepares it for future challenges and innovations. By politically integrating this initiative the responsibility for successful technology implementation is not only on the individual healthcare professionals as this initiative also indicate a politically responsibility.

Recognizing and incorporating technological literacy and initiatives improving the work environment is based on this study and suggested as a potential solution to overcome the challenges in the Danish healthcare system. Ensuring that healthcare professionals are equipped with the necessary digital skills enables them to more effectively adopt new technologies potentially leading to improved patient care. By prioritizing digital literacy, healthcare organizations and policymakers can create a more robust and responsive healthcare system capable of leveraging innovations that can address the current and future challenges. While the work environment is found to highly affect technology implementation this is also an initiative that might improve the process of technology implementation at hospitals. These suggested potential solutions and potential outcomes may

contribute to more robust and socially responsible technology implementations in hospitals, illustrated in the flowchart below:

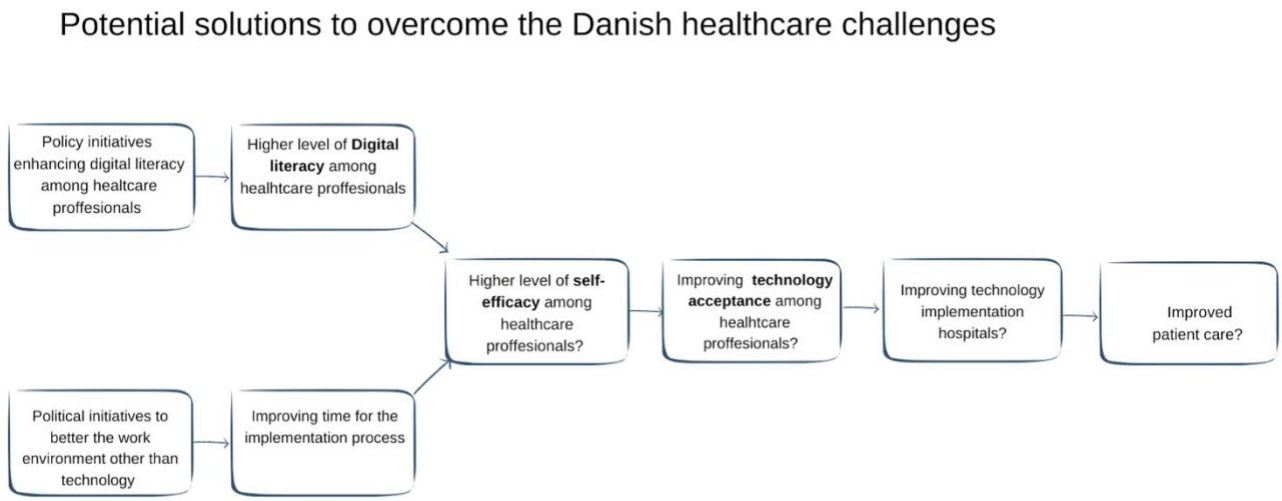


Figure 16 Potential solutions to overcome the Danish healthcare challenges

Can technology solve the healthcare crisis alone?

The integration of technology in healthcare is politically prioritized as a solution to the challenges faced in healthcare, addressed as the Danish healthcare challenges. However, this discussion underscores that while technology can offer benefits in prioritizing and improve patientcare, factors such as digital literacy and the work environment in hospitals should be considered to enhance the implementation process. The case of Teton.ai at the Neurological Ward in Nordsjællands Hospital demonstrates that healthcare professionals with higher levels of technological skills are more motivated in integrating the new system into their workflows. A supportive work environment that includes time for integrating technologies, training, and education might be needed to improve the integration of technology. If these factors that influence technology implementation in hospitals is not recognized and initiatives to overcome them is lacking, it might not be possible to overcome the Danish healthcare challenges with technology. This study highlights the significant role that user involvement has in successful implementation of technologies in hospitals. Highlighting the need for a Techno-Anthropological approach that consider the human and social dimensions when integrating technology in hospitals.

Building on this study the work environment and digital literacy among healthcare professionals is a factor that influences the implementation of technology in healthcare. Additionally further research is needed to investigate to which level this is a widespread issue in technology implementation in hospitals. If this is the case further research should be investigated to gain knowledge on how to improve digital literacy among the many different healthcare groups and generations. Considering the size of this study it is also important to acknowledge that this study might have overlooked certain aspects. Leading over to the following section where some of reflected limitations of this project is described.

Limitations

Despite the insights gained from this study limitations needs to be acknowledged. The ethnographic fieldwork was conducted over only two days at the Neurological Ward at Nordsjællands Hospital. This limited timeframe may not have captured the full picture of the healthcare professionals interactions and experiences with the Teton.ai system. Extended fieldwork could provide a deeper understanding of the long-term factors influencing the implementation of Teton.ai. Furthermore, the study's findings are based on a limited number of interviews and observations from only one hospital ward. While the insights unravel factors that influence the implementation of digital technology, they may not be generalizable to other wards or hospitals. Further research investigating digital technologies in other settings could enhance the generalizability of the results. This study focused specifically on the Teton.ai system. While this provides detailed insights into one technology it limits the applicability of findings to other technologies or settings.

Participants in the study volunteered to be part of the research which can be a bias. Those who chose to participate might have had a more positive or negative experience with the technology in healthcare which may have influencing the findings. For further research a more randomly selected group of informants could improve the relevance of the results and help limit this bias. My own background in nursing could be a bias influencing the data collection and understanding of the field. Although the concept of Epoché was applied to try to minimize preconceptions, complete neutrality is not possible to achieve. For further research students from other professions could join to the research group bringing more nuances into the research approach. While initiatives were applied to try to overcome this limitation, the potential for bias remains.

Due to the scope of the project some aspects are not outlined for example considering that Teton.ai is an AI technology, the ethical aspects of this could be investigated more narrowed. By acknowledging these limitations and highlighting areas for further investigation a foundation for future research to build upon this study is provided. This might bring more nuances to the involved dynamics and factors influencing the implementation and adoption of technologies in hospitals.

Conclusion

The integration of technology in healthcare is politically prioritized to address the Danish healthcare challenges. Health stakeholders focus on efficiency and fostering innovation, while healthcare professionals experience the practical benefits and challenges of technology implementation. This aligns with political initiatives aiming to overcome Danish healthcare challenges with the implementation of technology. Interviews with health stakeholders from Research and Innovation of Rigshospitalet, The Danish health technology council, Center for IT and Medical Technology and Copenhagen Health Innovation brought aspects on the structural factors influencing technology implementation in hospitals. The health stakeholders expressed that quality standards can delay implementation and that political motivations and prestige can influence technology adoption, sometimes overshadowing practical needs. The health stakeholders prioritize technology that is timesaving trying to overcome the challenges of work shortage. Healthcare professionals at the Neurological Ward find Teton.ai beneficial for enhancing patient care, especially during understaffed night shifts. Although managing multiple devices and alarms can be challenging for some of the healthcare professionals, suggesting a need for better integration to other digital devices.

Technological skills are a factor that highly influence how healthcare professionals adopt to new technology. Furthermore, the healthcare professionals with a higher level of technological skills positively affect their colleagues with les technological skills to integrate Teton.ai into their daily work. The healthcare professionals' level of *Digital literacy* might affect their level of *Self-efficacy* i.e., believe in ow capabilities in the end influencing *Technology acceptance*. While technology can improve patient care, factors such as digital literacy and the work environment in hospitals are found to be affecting implementation. The case of Teton.ai at the Neurological Ward in Nordsjællands Hospital shows that healthcare professionals with a higher level of technological skills are more motivated to integrate new systems. By focusing on enhancing digital skills, improving the work environment, and involving healthcare professionals in the technology implementation process, the potential benefits of new technologies can potentially be unlocked. Further research is suggested to fully underline to which extent digital literacy among healthcare professionals influence the implementation of technology in hospitals and an investigation of ways to improve digital literacy healthcare could help provide more specific solutions to overcome this.

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Personal communications:

Referred to as:	Organization	Personal communication
HS Danish health technology council	Health stakeholder working at The Danish health technology council	Pers.Comm.
HS 1 Research and Innovation of Rigshospitalet	Health stakeholder working at Research and Innovation of Rigshospitalet	Pers.Comm.
HS 2 Research and Innovation of Rigshospitalet	Health stakeholder working at Research and Innovation of Rigshospitalet	Pers.Comm.
HS CIMT	Health stakeholder working at Center for IT and Medical Technology	Pers.Comm.
HS CHI	Health stakeholder working at Copenhagen Health Innovation	Pers.Comm.

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