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A1. Summary

Finding a balance between dwindling resources and escalating demand is a challenge faced by healthcare services in many parts of the world. Application of technology is often seen as a solution to deal with this challenge and consequently the investment in IT deployment is rapidly increasing. However, the relationship between IT and healthcare performance is ambiguous: research indicates both positive and negative effects of IT in healthcare without explaining why and under which circumstances what kind of effect can be anticipated. Taking this situation as the point of departure, this thesis aims to create pragmatic knowledge on IT deployment in relation to healthcare performance from an operations management perspective. The specific problem statement is: How can IT deployment lead to performance improvement, and why does it fail to do so in many cases?

The research is framed following the context-intervention-mechanism-outcome logic from design science research to identify the underlying mechanism(s) through which IT deployment can lead to performance improvement. Mechanisms, being the scientific explanation of any outcome, can not only reveal the process of improving performance with IT, but can also indicate why, when, and what outcome can be expected. Accordingly, two empirical research questions are asked: (1) How does telemedicine deployment introduce changes in the service operations of care delivery processes in healthcare organizations? (2) What are the implications of these changes for healthcare performance?

A case study design has been used to examine two different telemedicine services, i.e., distance monitoring and remote consultation, for more than two years. Data were collected using qualitative methods, i.e., interviews, non-participatory observation, reports, and document accumulation. The unit of analysis was the service operation in the care delivery process of distance monitoring and remote consultation services. The main actors of these two care delivery processes, i.e., clinicians (i.e. physicians in specialized/secondary care units), general physicians (GPs) (i.e. physicians in primary care units), nurses, patients, and management, were interviewed at different times during the data collection period. Descriptive and pattern coding were the main data analysis methods. The structurational model of technology was used to conceptualize IT deployment; cocreation, performative model of routine, and professional service are other theoretical concepts used to analyze and explain the empirical material.

A systematic literature review and three empirical papers have been written as part of this thesis to answer the two research questions. The systematic review shows how extant literature addresses these issues and the empirical papers address them based on the distance monitoring and remote consultation services studied here. The findings from the papers can be summarized in terms of changes in the service operations, the mechanisms of performance improvement, and the associated implications. The changes triggered by IT deployment in service operations within the care delivery processes are new ways of interacting using

telephone and video calls; categorizing patients' needs to offer them the most suitable service channel; new coordination mechanisms, such as the distance monitoring app, individual treatment plan, and teamwork among GPs, nurses, and patients; and delegation of GPs' and clinicians' responsibilities to nurses and patients. These changes lead to improved efficiency and effectiveness of the care service through different mechanisms: generating less-expensive capacity leads to service cost reduction (efficiency); generating additional capacity leads to responsive service and reduction of waiting time (effectiveness); providing service alternatives leads to improved customization (effectiveness); providing preventive services leads to improved responsiveness and customization (effectiveness).

Based on the changes observed in the services, a set of operational paradoxes was identified: the paradox of coordination, paradox of decision-making, and paradox of changing roles. Each of these has two contradictory facets, which create challenges for the healthcare organizations implementing the IT. The paradox of coordination indicates that IT deployment creates new coordination opportunities but also requires new coordination processes to enable those IT-enabled coordination opportunities. The paradox of decision-making indicates that IT deployment facilitates data-driven decision-making, but also requires the healthcare personnel to make new types of decisions regarding a patient's suitability for IT-enabled services. The paradox of changing roles indicates that IT deployment facilitates patient empowerment and task automation but also adds new responsibilities and tasks to healthcare personnel as well as patients. In each paradox, one facet projects the rather positive side of IT deployment and the other facet projects the rather complex and demanding side of IT deployment.

Next, based on these paradoxes, I put forward a theoretical explanation of why, despite having the potential, IT deployment often fails to improve healthcare performance. I posit that IT deployment triggers two types of change in care delivery process: direct changes and complementary changes. Direct changes and complementary changes correspond to the positive and demanding facets of the paradoxes, respectively. Direct changes are the consequence of using any IT in a service, whereas complementary changes are organizational changes that must be established to support the direct changes. Currently, both literature and practitioners have paid inadequate attention to the complementary changes and put much emphasis on the direct changes that create a vague idea that IT deployment is successful and indicate some short-term performance improvement. However, it is the combination of direct and complementary changes that would make an IT implementation successful and thereby improve performance.

Lastly, I argue that there is a mismatch between the current design of healthcare services and the requirements posed by IT deployment. On one hand, healthcare services are specialized services rendered by professionals that are function-oriented, standardized and have a rigid division of labor. On the other hand, IT-enabled services require a service structure that is process-oriented, flexible, and of a collaborative nature. This mismatch makes it difficult for

healthcare organizations to establish the complementary changes. Thus, they focus on rather low-hanging fruits: the superficial benefits of IT deployment resulting from the direct changes. Consequently, IT deployment fails to improve healthcare performance in a sustainable way and the relationship between IT deployment and healthcare performance remains ambiguous.

A2. Sammendrag

Å finne en balanse mellom minkende ressurser og økende krav er en utfordring som møter helsetjenester i store deler av verden. Bruk av teknologi er ofte sett som en løsning for å håndtere denne utfordringen og derfor øker IT-investeringene kraftig. Men, økt IT-implementering bidrar ikke alltid til bedre helsetjenester. Forskning viser både positive og negative effekter av IT-implementeringer innen helse uten å forklare hvorfor og under hvilke omstendigheter hva slags effekt kan forventes. Basert på denne situasjonen er målet i denne avhandlingen å skape pragmatisk kunnskap om IT-implementeringer i relasjon til ytelsene i helsevesenet fra et virksomhetsledelsesperspektiv. Spesifikt undersøkes: hvordan kan IT-implementeringer gi forbedret ytelse og hvorfor gjør det ikke det i så mange tilfeller?

Forskningen er basert på et rammeverk fra designvitenskapelig forskning, kalt kontekst-intervensjon-mekanisme-utkomme (CIMO) hvor man identifiserer de underliggende mekanismene der IT-bruk kan lede til ytelsesforbedringer. Mekanismene er vitenskapelige forklaringer av ethvert utkomme, og de kan ikke bare vise fram prosessen med å forbedre ytelsen med IT, men også indikere hvor eller når, hvilket utkomme kan forventes. Derfor undersøkes to empiriske forskningsspørsmål: (1) Hvordan introduserer innføringen av telemedisin endringer i hvordan omsorgstjenester utføres i helseorganisasjoner? (2) Hva er implikasjonene av disse endringene for utførelsen av helsetjenestene?

Forskningsdesignet har vært case studie der to forskjellige typer telemedisin, avstandsmonitorering og avstandskonsultasjon har blitt studert i over to år. Datainnsamlingen har blitt gjort med kvalitative metoder som intervju, ikke-deltagende observasjon, rapport (?) og innsamlede dokumenter. Analyseenheten var måten helsetjenester ble utført på under avstandsmonitorering og – konsultasjon. De sentrale aktørene i de to tjenestene, klinikere, legere, sykepleiere, pasienter og ledelse ble intervjuet på forskjellige tidspunkt i løpet av datainnsamlingsperioden. Deskriptiv koding og mønsterkoding var hovedanalysemetodene. Den strukturerende modellen av teknologi er brukt for å konseptualisere IT-bruken: samskaping, en performativ modell av rutine og profesjonelle tjenester er andre teoretiske konsepter brukt for å analysere og forklare det empiriske materialet.

En systematisk litteraturgjennomgang og tre empiriske artikler ble skrevet som en del av denne avhandlingen for å besvare de to forskningsspørsmålene. Litteraturgjennomgangen illustrerer hvordan forskningen opp til nå har behandlet disse spørsmålene, og de empiriske artiklene adresserer spørsmålene med den forskningen som er gjort her på avstandsmonitorering og -konsultasjon. Funnene fra artiklene kan oppsummeres med endringer i utførelsen av tjenestene og de mekanismene for ytelsesforbedring de impliserer. Endringene som ble trigget av bruken av nye IT-løsninger i omsorgstjenestene er; nye måter å interagere med telefon og videosamtaler; sortering av pasientbehov for å tilby dem den mest passende kanalen for tjenesten; nye koordineringsmekanismer som en avstandsmonitoreringsapp; individuelle behandlingsplaner; samarbeid mellom lege, sykepleier og pasient; og delegering av leger og klinikere sitt ansvar til sykepleiere og

pasienter. Disse endringene ledere til økt effektivitet og forbedrete tjenester gjennom forskjellige mekanismer: generering av billigere kapasitet leder til kostnadsreduksjon (effektivititet); generering av tilleggskapasitet leder til mer responsive tjenester og redusert ventetid (forbedring); å tilby flere alternative måter å utføre tjenesten på leder til økt tilpasning (forbedring); å tilby forebyggende tjenester leder til forbedret svartid og tilpasning av tjenestene (forbedring).

Basert på endringene som ble observert i tjenestene ble et sett av operasjonelle paradokser identifisert. Disse ble kalt: koordineringsparadokset, beslutningstakingsparadokset og paradokset med endrede roller. Hver av dem har to motstridende fasetter som gir en utfordring for helsevesenets innføring av IT. Koordineringsparadokset indikerer at det å ta i bruk nye IT-løsninger gir nye muligheter for koordinering, men også krever nye koordineringsprosesser for å gjøre mulig slike IT-støttede koordineringsmuligheter. Beslutningstakingsparadokset indikerer at det å ta i bruk nye IT-løsninger støtter datadrevet beslutningstaking, men også krever at helsepersonell må ta nye beslutninger om hvorvidt pasienten er i stand til å bruke slike IT-tjenester. Paradokset med endrede roller indikerer at det å ta i bruk nye IT-løsninger støtter myndiggjøring av pasienten og automatisering av oppgaver, men også gir nytt ansvar og nye oppgaver til helsepersonell og pasientene. I hvert paradoks viser den ene fasetten de positive sidene av det å ta i bruk nye IT-løsninger, mens den andre fasetten viser de komplekse og krevende sidene av slik ibruktaking.

Dernest, basert på disse paradoksene, gir jeg en teoretisk forklaring på hvorfor, på tross av sitt potensiale, innføringen av nye IT-løsninger ofte ikke fører til forbedringer i helsetjenestene. Jeg foreslår at IT-innføring setter igang to typer endringer i utførelsen av helsetjenesten: direkte endringer og komplementære endringer. Direkte endring og komplementære endringer korresponderer til de lettere og krevende fasettene av paradoksene. Direkte endringer er konsekvensen av å bruke en IT-løsning, mens komplementære endringer er organisasjonsendringer som trengs for å støtte de direkte endringene. Til nå, har både forskning og praksisfeltet gitt for lite oppmerksomhet til de komplementære endringene og plassert mye vekt på de direkte endringene som gjør at det ser ut som IT-innføringen er vellykket fordi man ser noen forbedringer på kort sikt. Men, det er kombinasjonen av direkte og komplementære endringer som vil lede til en suksessfull IT-innføring med forbedret ytelse.

Til slutt argumenterer jeg for at det er misforhold mellom det eksisterende designet av helsetjenester og kravene som IT-innføring gir. På den ene siden er helsetjenester spesialiserte tjenester som gis av profesjonelle som er funksjons-orienterte, standardiserte og har en rigid arbeidsfordeling. På den andre siden krever IT-støttede tjenester en tjenestestruktur som er fleksible, prosess- og samarbeidsorientert. Dette misforholdet gjør at det er vanskelig for helseorganisasjoner å etablere de komplementære endringene. Derfor fokuserer de på lavthengende frukt – overfladiske fordeler av IT-innføring som kommer fra de direkte endringene. Som en konsekvens av dette gir ikke IT-innføringen de gevinster som man ønsker, og forholdet mellom IT-innføring og ytelse i helsetjenestene forblir tvetydige.

B. Acknowledgments

I have been through the saddest and happiest moments of my life during the PhD project. None of these were related to the project though. Nevertheless, this thesis and the work that went toward it symbolize endurance and balance, which I managed to bring forth only because of the wonderful support system I have.

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anything and everything. Thank you for being anchors in a foreign land. Because of you, even Trondheim feels warm and bright most of the time.

I want to thank my ex-husband who found this PhD project and forwarded it to me saying that it is a great match for me. It was indeed a great match, so thank you. I thank my six girlfriends living in three different continents. Thank you for cheering for me all the time without even knowing the topic of my research. Lastly, I express my gratitude to my family, the reason for my being. Your unconditional acceptance of me simply as the human that I am makes my life easier, let alone the writing of this thesis. Rohini, my Rooh-Pooh, if you ever read this, please know that Mashi was not there when you came to the world because of this body of work, but she loves you more than anything in this world.

C. Abbreviation

CIMO	Context-intervention-mechanism-outcome
COPD	Chronic obstructive pulmonary disease
CPOE	Computerized physician order entry
CT	Computed tomography
DM	Distance monitoring
DSR	Design science research
EDI	Electronic Data Interchange
EHR	Electronic healthcare record
EMR	Electronic medical record
ERP	Enterprise resource planning
EU	European Union
GP	General physicians
HF	Heart failure
HIMMS	Healthcare Information and Management Systems Society
HIT	Health information technology
HR	Human resource
IS	Information system
MC	Multi-channel
MS	Medical science
NSD	Norwegian Centre for Research Data
NTNU	Norwegian University of Science and Technology
OM	Operations management
OS	Organizations Study
PC	In-person consultation
PDA	Personal digital assistant
PM	PubMed
POC	Point of contact
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
RC	Remote consultation
REK	Medical and health research ethics
RFID	Radio frequency identifier
RQ	Research question
SERVQUAL	Service Quality
TAM	Technology acceptance model
TC	Telephone consultation
TTF	Task technology fit
UN	United nations
UTAUT	Unified theory of acceptance and use of technology
VC	Video consultation
WHO	World Health Organization
WoS	Web of Science

D. Structure of the thesis

This is an article-based thesis (as opposed to monograph) and consists of two parts: the main report and four independent articles written for this PhD research. The main report (chapters 1 to 9) synthesizes the findings and contributions of the articles and connects them to the overarching aim of the thesis.

The independent articles have been submitted to international journals and three of them have been published, whereas the fourth is currently under review. The four articles are:

1. Enam, Amia; Dreyer, Heidi Carin; Ingvaldsen, Jonas A; Boer, Luitzen de. (2022), Improving healthcare operations with IT deployment: A critical assessment of literature and a framework for future research. *International Journal of Healthcare Management and Technology.* Vol. *19*(3–4). doi:10.1504/IJHTM.2022.10051288

2. Enam, Amia; Dreyer, Heidi Carin; Boer, Luitzen de. (2022) Individuals' perceptions as a substitute for guidelines and evidence: Interview study among clinicians on how they choose between in-person and remote consultation. *JMIR Formative Research.* Vol. *6*(5). doi: 10.2196/35950

3. Enam, Amia; Dreyer, Heidi Carin; De Boer, Luitzen. (2022) Impact of distance monitoring service in managing healthcare demand: A case study through the lens of cocreation. *BMC Health Services Research.* Vol. *22*(1). https://doi.org/10.1186/s12913-022-08164-2

4. Enam, Amia; Sousa, Rui; Dreyer, Heidi Carin. Multichannel consultation service design in hospitals: Implications for service efficiency and effectiveness. Under review since May 2023.

In the main report, I use the terms "study," "project," and "research work" as synonymous with "thesis," whereas the term "case study" indicates the two empirical cases, and "article" and "paper" indicate the four independent articles listed above. I have used the term clinicians to refer to the physicians working in the specialized care units and the term general physicians (GPs) to refer to the physicians working in the primary care units.

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Part I – Main Report

1. Introduction

IT deployment in healthcare is a global phenomenon drawing the attention of researchers and practitioners from multiple disciplines. This thesis analyzes this phenomenon from the perspective of operations management (OM). Specifically, the aim of the thesis is to create pragmatic knowledge on IT deployment in relation to healthcare performance from an OM perspective.

In the following sections of this chapter, I describe the background that signifies the importance of studying the phenomenon of healthcare IT deployment and then I outline the research gap that predicates the relevance of the aim of the thesis. The rest of the thesis is structured as follows: chapter 2 explains how the aim of the thesis is reached through the research framework and research questions (RQs); chapter 3 discusses the main theoretical concepts used to define and explain the empirical material; chapter 4 outlines the overall research design including case selection, data collection, and analysis; chapter 5 provides summaries of the articles that constitute this thesis; chapter 6 answers the RQs; chapter 7 extends the findings from chapter 6 to address the problem statement and discuss how the thesis contributes in creating pragmatic knowledge on improving healthcare performance through IT deployment; chapter 8 discusses how the thesis contributes to practice; chapter 9 makes concluding remarks and identifies scope for future research. The full text of the four articles is included at the end of the thesis.

1.1 Background: expectation vs. reality of IT deployment in improving healthcare service

Researchers, practitioners, and global organizations seem to be in consensus that the current healthcare system is not sustainable and much more attention is needed to improve its condition (Laurenza et al., 2018). One of the 17 sustainability development goals set by the United Nations (UN) is to ensure good health and wellbeing for all by 2030; this goal has already been declared unattainable as progress is not sufficient according to the recent evaluation report (United Nation, 2020). The same report also indicated several challenges in the current healthcare system, including a shortage of healthcare personnel across roles and geographies, and rises in healthcare costs as well as demand. In addition to resource constraints, the growing numbers of elderly people, chronic diseases, multi-morbidities, and mental illness require different kinds of care arrangements that the current system is not equipped to deliver (Ding et al., 2019). While advancements in diagnostic tools and techniques have created opportunities for timely service, they have also increased demands for specialized care and, therefore, specialized skills, which are difficult to meet. The scarcity of resources in healthcare has become more visible since the Covid-19 pandemic started. During the pandemic, healthcare organizations across the world struggled to serve patients suffering from Covid-19 as well as other diseases as and when required, revealing the vulnerable status of the current healthcare system. A robust and flexible healthcare system should be built that can support special situations without jeopardizing regular care delivery processes.

Norway, the country where this research has been conducted, is not immune to these challenges. Growing demand and dwindling resources are making it difficult to maintain the quality of care in both primary and specialized healthcare in Norway (Helsepersonellkommisjonen, 2023). Not only are insufficient numbers of personnel being educated each year for the different responsibilities in the healthcare service, but the number leaving the healthcare profession, particularly general physicians (GPs), is at an all-time high (Rebnord et al., 2018). A recent report called for action to restructure the way specialized hospitals are organized, managed, and funded (Sykehusutvalget, 2023). The same report indicated that the interaction and coordination between the primary and specialized care is not satisfactory and needs to be improved.

Overall, there is an urgent need to find solutions to meet demands while maintaining quality of care and minimizing resource utilization (Dobrzykowski, 2019). Application of technology to resolve societal challenges is nothing new and IT, being the latest addition to the technological revolution (Perez, 2002), is expected to play a significant role in alleviating the current healthcare situation. Known as the fifth wave of technology revolution, computer and telecommunication technologies have been deployed in workplaces since 1970, and continuous innovation in microelectronics, the internet, computers, and mobile technology have created ample opportunities for new industries and triggered major changes in existing industries (Bodrožić & Adler, 2018). IT deployment in healthcare is a part of this technological revolution and increasingly high investment from both public and private entities in implementing IT tools and in different research projects indicates that the healthcare community also have high expectations from IT deployment (Agarwal, 2020; Agarwal et al., 2010). IT deployment is a means to improve healthcare performance; this thesis takes this notion as the point of departure and probes it further.

Before delving into the gaps in the literature, I briefly clarify how the terms OM and IT deployment—the dominant research field and the phenomenon of interest of this thesis—have been outlined. Owing to the high degree of interaction with other research fields, it is difficult to draw a clear boundary for OM (Pilkington & Fitzgerald, 2006; Slack, Lewis, et al., 2004; Voss, 1984). Nonetheless, OM includes the design of goods, services, and the processes that create them; the management of those processes; and the continual improvement of these goods, services, and processes (Collier & Evans, 2020). Although these are the focal areas of OM in both manufacturing and services, the way they are achieved significantly varies across these two domains (Ellram et al., 2004; Johnston, 2005). Thus, in the thesis, OM implies the field of service operations management. Furthermore, this thesis focuses on operations that constitute the transformation process through which inputs are converted to outputs, which is a fundamental aspect of OM (Hill & Hill, 2011; Slack, Chambers, et al., 2004). The strength of OM lies in studying, analyzing, and optimizing operations for better performance (Chopra et al., 2004). Thus, I use the lens of OM to identify how IT deployment affects the operations of care delivery processes and how these effects can be managed to improve

healthcare performance. Instead of measuring performance, the emphasis is given to the process through which the performance can be improved.

IT refers to the "technologies for the processing, storage, and transmission of digital material, consisting of ensembles of hardware and software with distinctive feature sets allowing for the physical storage and logical representation of different forms of data" (Mutch, 2010), p.507). IT deployment refers to the application of IT for communication and decision-making (Thompson & Brailer, 2004). A subset of healthcare IT known as telemedicine—tools that enable delivery of care when the care provider and receiver are geographically distant (Hyder & Razzak, 2020)—is the empirical choice of IT in this thesis, and will be elaborated in the next two chapters. The general expectation from healthcare IT deployment includes better coordination of care, faster and error-free decision-making, responsive and patient-centered care provision, and patient empowerment (Alloghani et al., 2018; Chen et al., 2013; Drupsteen et al., 2016; Laker et al., 2018).

A gap exists between these expectations and reported benefits realized from IT deployment in healthcare. The investments in healthcare IT are most often driven by the promises it offers rather than clear evidence of improvements in healthcare (Greenhalgh et al., 2018; Rigby & Ammenwerth, 2016). Moreover, evidence of risks and harms caused by different IT applications in healthcare also exists (Adler-Milstein et al., 2014; Zanaboni, 2016). A study conducted by Boston Consulting Group in late 2020 reveals that 70% of digital transformation projects never achieve their goal and end up with significant setbacks or suboptimal results (Forth et al., 2020). Moreover, the massive organizational challenges and irregularities that occurred during the implementations of an electronic healthcare record (EHR) system in Denmark and more recently in one of the biggest regions in Norway indicate that our understanding of IT deployment is yet to be matured. Therefore, it is in our interests to not assume that IT deployment equates to performance improvement. Being a field of applied science and having a strong focus on improving performance by creating pragmatic knowledge to solve organizational conundrums, OM is deemed to be a promising perspective to study the ambiguousness that exists between IT deployment and healthcare performance. However, as the next section explains, a clear research agenda on healthcare IT deployment is required to answer whether, to what extent, how, and under what circumstances IT deployment can solve the current healthcare challenges. This thesis substantiates the necessity of such an agenda and partly answers these questions.

1.2 Gap in the literature: Limited answers to the why and how of IT deployment

OM studies have taken a narrow perspective on studying healthcare IT deployment (Aceto et al., 2018); the contribution of the growing literature has been random and thus falls short in developing a holistic body of knowledge (Yang et al., 2015) and there is a lack of alignment between the practical challenges and the academic focus (Tortorella et al., 2020). The research on healthcare IT in OM can broadly be divided into two streams: analysis of the impact of IT on healthcare performance and analysis of IT adoption (Agarwal et al., 2010; Enam, Dreyer,

Ingvaldsen, et al., 2022). The first stream has predominantly aimed to establish a relationship between IT and organizational-level performance using statistical inference. While these studies have enhanced our empirical understanding of certain healthcare IT interventions, they have made limited contributions in explaining how the application of IT leads to performance changes (Gastaldi et al., 2018). This explanation is important because both positive and negative impacts have been reported by different studies, indicating that the relationship between IT and healthcare performance is not straightforward (Gardner et al., 2015).

The second research stream has used different adoption models, such as the technology acceptance model (TAM; (Davis, 1989) and the unified theory of acceptance and use of technology (UTAUT; (Venkatesh et al., 2003), which are based on the theory of planned behavior (Ajzen, 1991). These studies are set on the premise that whether individuals in an organization will use a technology, i.e., their behavior towards technology, depends on their intentions and the perceived benefits of technology. These studies were deductive where models such as TAM and UTAUT have been tested with empirical data (e.g., (Chau & Hu, 2001; Chong et al., 2015; Ilie et al., 2009), and some of them have extended the model by adding new constructs such as personal innovativeness (Alsyouf & Ishak, 2018; Yi et al., 2006). While these studies provided interesting empirical insights, they engaged in little new theorizing and thus made limited contribution in explaining the low adoption rate of healthcare IT (Fox et al., 2020; Greenhalgh et al., 2017).

Moreover, both of these research streams treat IT as an abstract concept with some discrete processing capabilities without specifying the technology: a recent literature review found that 38% of the articles included in the review did not mention any particular IT but used it as a concept without specifying characteristics (Enam, Dreyer, Ingvaldsen, et al., 2022). Fewer than 5% of studies described IT at a functional level, i.e., specifying the properties, and those studies identified that each function could impact healthcare performance differently (Kazley & Ozcan, 2008; Li et al., 2020; Plantier et al., 2017). The lack of clarification of the content and properties of IT limits our understanding of IT deployment and its consequences in organizations (Colucci, 2015; Kallinikos et al., 2013; Orlikowski & Iacono, 2001). Additionally, as mentioned earlier, the current OM literature has focused more on measuring performance attributes and correlating them with IT deployment. Overall, the research trend has been to focus on the outcomes of IT deployment, rather than the causes of those outcomes (Enam, Dreyer, Ingvaldsen, et al., 2022). A processual assessment that explains the causes and demonstrates how deployment of IT translates to performance change is scarce. Both IT and performance have been treated as a black box, i.e., a device that is described simply in terms of input and output, while its contents, structure, and origin have been neglected for convenience (Winner, 1993), providing a superficial understanding of how IT deployment can improve healthcare performance (Enam, Dreyer, Ingvaldsen, et al., 2022).

In summary, amidst a major resourcing crisis in the global healthcare sector, investment in IT deployment is increasing rapidly. However, promised benefits are rarely realized and implementation projects often fail to sustain large-scale applications of IT. The extant literature has not sufficiently pinpointed what it is about IT that can fulfill these expectations and how exactly IT deployment leads to improvement (or deterioration) in healthcare. I posit that both of these aspects require in-depth study to identify how IT deployment can (or cannot) alleviate the current problems in healthcare, which is crucial to set the course of financial investments, research initiatives, and organizational efforts in healthcare IT deployment in the right direction. Thus, the problem statement of the thesis is: how can IT deployment lead to performance improvement and why does it fail to do so in many cases? The specific RQs are developed in the next chapter.

2. Frame of research

As this thesis does not focus on measuring the impact of IT deployment, but rather on capturing the process through which IT deployment impacts healthcare organizations, a theoretical frame that could elucidate how to conduct such research was essential. Figure 1 shows the overarching research framework that has been developed based on context-intervention-mechanism-outcome (CIMO) logic from design science research (DSR) (Denyer et al., 2008; van Aken et al., 2016). DSR is a research approach that is well positioned within OM because of its simultaneous focus on providing theoretical insight and pragmatic solutions (Oliva, 2019; van Aken et al., 2016). Besides OM, this approach is well known in information systems research (Baskerville et al., 2018), medical research (Tanila et al., 2020), etc. CIMO originated in the field of realist evaluation, which is positioned within critical realism (Pawson & Tilley, 1997). According to critical realism, mechanisms are the underlying scientific explanations of any outcomes that cannot be observed empirically, but are constructed theoretically from empirical observations (Reed, 2005). Based on this definition of mechanisms, CIMO logic posits that in a (problematic) context, an intervention can lead to certain outcomes through certain mechanisms (Denyer et al., 2008). According to this logic, an intervention produces outcomes through mechanisms, and an understanding of the mechanisms facilitates the design of the intervention so that the intended outcomes can be achieved.

The CIMO approach was deemed appropriate to address the problem statement raised here because (1) the purpose, like CIMO logic, is to understand how the expected outcome, i.e., performance improvement, can be achieved through IT deployment; (2) furthermore, CIMO logic clarifies that the identification of mechanisms can lead us to this understanding; and (3) it does not limit the application of other theories or concepts to define and explain the context, intervention, mechanisms, and outcomes. Therefore, CIMO has been used as the skeleton of the research framework. Here, the context is the public healthcare system that is struggling to maintain quality of care while meeting rising demand with dwindling resources; the intervention is IT deployment in healthcare organizations; the mechanisms are the concepts through which IT deployment can bring changes in healthcare performance, i.e., the outcome.

Next, it was important to specify how exactly the mechanisms could be identified. Because the mechanisms are not empirically observable, they can only be inferred from the tendencies or regularities produced under certain conditions (Lawson, 2007). However, CIMO logic does not delve into the discussion on how to infer mechanisms from empirical observation. Therefore, a research framework (figure 1) has been applied to infer the mechanisms of healthcare performance improvement through IT deployment. This framework proposes a way of identifying the mechanisms and was developed as a part of the systematic literature review, which is one of the four articles of this thesis.

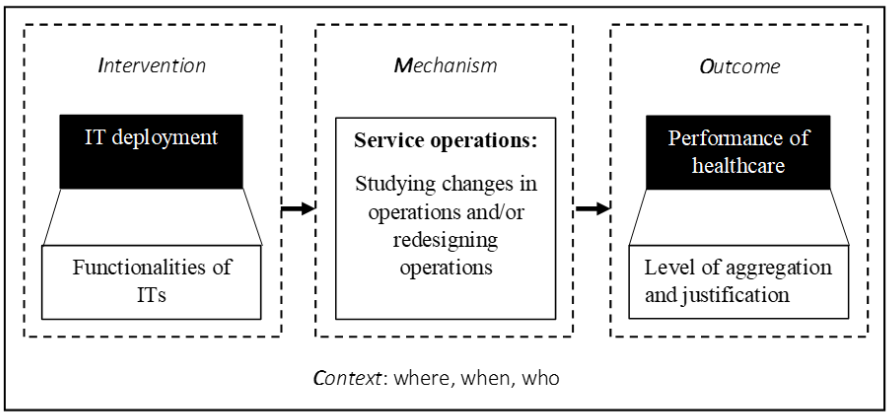

Figure 1: Research Framework

According to the research framework, the mechanisms of IT deployment can be better understood by analyzing the changes in the service operations of care delivery processes where the IT is being put to use, because it is those changes that ultimately translate into performance alterations and thus the empirical means to infer the mechanisms (Enam, Dreyer, Ingvaldsen, et al., 2022). Moreover, the framework focuses on studying a specific IT and analyzes the changes in service operations in relation to the functionalities of the IT under study, because, depending on these functionalities, different types of IT may have different mechanisms. Previous research has also concluded that the findings of empirical studies that used IT as a concept without specifying the functionalities have had limited application and little contribution in generating knowledge (Mutch, 2010; Orlikowski & Iacono, 2001). Therefore, the empirical studies conducted as the part of this thesis focused on a specific type of IT, i.e., telemedicine. Based on the framework, the two RQs that guided the research conducted for this thesis are as follows:

RQ 1: How does telemedicine deployment introduce changes in the service operations of care delivery processes in healthcare organizations?

RQ 2: What are the implications of these changes for healthcare performance?

The first RQ focuses on the process of using the IT (telemedicine in this case) in the care delivery process and how it alters the ongoing service operations. The second RQ then focuses on how these changes in operations can impact healthcare performance. Both RQs contribute to creating a processual understanding of how IT deployment leads to performance improvement. The mechanisms (see chapter 6, table 3) are inferred by analyzing the observed changes in service operations in relation to the relevant theoretical concepts. While these RQs

guide the research to address the first part of the problem statement—how IT deployment can lead to performance improvement—the second part—why it does not do so in many cases—is answered by developing a theoretical explanation based on the empirical findings and the identified mechanisms.

3. Theoretical positioning

This chapter presents the latest literature, theories, and concepts that are pertinent to the thesis. The chapter is divided into four sections following the components of the research framework (figure 1): *service operations*, *healthcare performance, IT deployment,* and *context*. The aim of this chapter is to describe how each of these components are understood in the extant literature and which relevant theoretical concepts have been used to address the RQs and the problem statement. First the literature of OM is explored to characterize healthcare service operations and healthcare performance. Then how IT deployment is viewed by different streams of literature and how it is conceptualized here are discussed. Lastly, a brief discussion on how context is taken into consideration in the literature and in this thesis is presented.

3.1 Characterizing healthcare service operations

The early literature on service operations management, a sub-domain of OM dates back to the 1970s (Chase, 2010; Silvestro et al., 1992). Since then, the field has evolved from simply transposing manufacturing concepts into the service environment to recognizing the need for a multidisciplinary approach that fits service characteristics (Heineke & Davis, 2007). Intangibility, simultaneity of production and consumption (also known as immediacy and inseparability), and co-creation were identified as features of service that separate it from manufacturing (Osborne & Strokosch, 2013; Sasser, 1976; Shostack, 1977, 1984). Consequently, operations design, planning and control, and performance evaluation, the key tasks of OM, require different considerations (Ellram et al., 2004; Sasser, 1976; Silvestro et al., 1992). In this section, I first pinpoint the features that are particularly relevant for healthcare service operations with the help of extant literature and then discuss how these features are treated in this thesis.

There are several matrixes or spectrums where services are categorized based on different features. Chase (1978, 2010) used customer contact as the dimension to classify services as pure service (high contact), mixed service (medium contact), and quasi-manufacturing (low contact). According to this continuum, the higher the customer contact, the harder it is to separate the back office from the front office and, consequently, the less control managers have over service operations. Therefore, efficiency is more difficult to attain in services with higher customer contact compared with services with lower customer contact. Chase's continuum is very relevant because it is based on an inherent feature of service: the presence of customers in the service creation process. However, there are other features of service that can vary for services with the same customer contact time and thus require different management techniques, and these cannot be explained using this continuum. Second, the service process model of Silvestro (1999) and Silvestro et al., (1992) maps different service types, plotting variety against volume and proposing a correlation between them. These authors identified three archetypes of service, namely, professional service (low volume, high

variety), service shops (mid-level volume and variety), and mass service (high volume, low variety). Critics of the service process model have argued that given the dynamic and iterative nature of service, volume (i.e., customers served per unit time) lacks clarity and relevance as a concept to characterize service; and the model includes a number of concepts, e.g., contact time, customization, discretion, front–back office orientation, within the variety axis, which is questionable given that the relations between these concepts are not clarified and they can each have different correlations with volume (Collier & Meyer, 1998).

Next, based on swift, even flow theory, the service process matrix of Schmenner (2004) identifies a 4 by 4 matrix using degree of variation and throughput time. The service typology includes mass service, service factory, service shop, and professional service. In line with the criticism of the service process model, it can be said that the concept of throughput time can be as problematic as volume because of the iterative nature of some services. On the other hand, the variety in this model represents both customization and degree of interaction with customers where these two may not have same correlation with throughput time. Another service typology was proposed by Collier and Meyer (1998), namely the service positioning matrix. Using the perspective of the design of a service delivery system, they chose degree of repeatability in customer service encounter activities and the number of available service delivery pathways. They posited that, depending on the degree of repeatability, the service design should vary, i.e., if the service encounter activities are highly repeatable then the service pathways can be limited and vice versa. They categorized services into three groups: provider-routed (high repeatability, few pathways), co-routed (medium repeatability and pathways), customer-routed (low repeatability, more pathways).

Taking Hayes and Wheelwright's (1979a and 1979b) product-process matrix as a point of departure, the above-mentioned models categorize service archetypes using different operational characteristics, namely customer contact, repeatability of customer encounter, available pathways of encounter, variety, customization, discretion, and front–back office orientation. In all these models, the healthcare service has been positioned toward one of the extremes as having the most variety and customization (Collier & Meyer, 1998; Schmenner, 2004), highest contact time (Chase, 1978, 2010), and need for specialized skill and knowledge (Silvestro, 1999). Chase (2010) referred to this as a pure service, indicating that managing healthcare operations probably has more distinctive aspects compared with managing production; in other words, among all services, the operational characteristics of the healthcare service are least similar to the characteristics of manufacturing or production of goods.

To summarize, healthcare service operations can be characterized as people-focused, front-office-oriented, and labor intensive, requiring high levels of customer contact, customization, and discretion of healthcare professionals. The nature of the value creation process depends on the operational characteristics of a production or service process (Stabell & Fjeldstad, 1998). The value creation process in a healthcare service, i.e., care delivery process, is

characterized by information asymmetry; cyclical, iterative, and interruptible activities; significant sequential and reciprocal interdependence between activities; and multiple disciplines and specialties in spiraling activity cycles (Christensen et al., 2010; Stabell & Fjeldstad, 1998). To better identify and understand these characteristics of service operations within the care delivery processes empirically observed in this research, the literature of service cocreation, professional service organization, and organizational routine was examined. The service cocreation concept captures the simultaneous production and consumption of a service, as well as the inevitable participation of patients in the care delivery process (Cluley et al., 2021; Lusch & Nambisan, 2015). The professional service literature could explain the dynamics among different actors, such as clinicians, GPs, nurses, management, and patients. Owing to information asymmetry, i.e., the specialized clinical knowledge gap between clinicians and the other actors, the former holds a unique position in the care delivery process (Levay & Waks, 2009; Lusch & Nambisan, 2015). The organizational routine literature has been used to systematically capture the changes triggered by IT deployment in service operations performed by different actors in the care delivery process. A brief introduction of this literature is provided in the following subsections.

3.1.1 Professional dynamics in care creation

A profession, by definition, has a knowledge base, methodology, and language that are unique and require much training to master (Abbott, 1988). The central aspect that differentiates professional services from other services is this mastery over a particular expertise or knowledge base (Von Nordenflycht, 2010). Professional service sectors, such as healthcare, have unique operational configurations to address the challenges arising from the nature of the tasks the professionals perform and the nature of the professionals themselves (Goodale et al., 2008). The nature of the tasks has been briefly touched upon while characterizing healthcare service operations, e.g., high customization, high customer contact time, front-office-oriented operations. Apart from these, task complexity and the need for expertise set professionals' tasks apart from other service operations. Complexity of professional tasks refers to tasks being unstructured or unsuitable for scripting or automation, and having high outcome uncertainty and serious impacts, such as injury, death, or malpractice litigation (Campbell, 1988a; Dobrzykowski et al., 2016; Goodale et al., 2008; Von Nordenflycht, 2010). The professionals are characterized as discreet, autonomous, and difficult to manage (Levay & Waks, 2009; Zardkoohi et al., 2011). Their control mechanism is mostly self-supervision and collegiate reviews (Freidson, 2001). The professionals may have difficulty in balancing their self-interest with the interests of the organization (Jones et al., 1998).

In relation to IT deployment, the professional nature of healthcare services can have a significant role to play. The adaptation of IT in a healthcare setting can change the care creation tasks depending on to what extent and how these professionals use the IT. The extant literature has indicated that the automation of care, which is often seen as the key change IT enables, is difficult due to the nature of the tasks (Sampson, 2021). On the other hand, professionals tend to resist any changes in their work that may adversely affect their

autonomy or lower their discreetness (Levay & Waks, 2009). In particular, physicians at the peak of their profession have repeatedly expressed reservations about different IT systems, either for their inability to meet physicians' needs or the apprehension of decreasing quality of care (DesRoches et al., 2008; Simon et al., 2007) Therefore, the explanation of how and why IT deployment leads to certain outcomes in healthcare needs to include the lens of professional service. However, as explained in the next section, care creation activities are conducted by a range of personnel from different healthcare professions (e.g., physicians, nurses, physiotherapists). Thus, the usefulness and applicability of the professional lens varies depending on which activities are most exposed to the IT deployment under study.

3.1.2 Cocreation of care

Customers provide significant inputs, including body, mind, and information, to the service creation process, making this process explicitly interactional rather than a unidirectional flow of service from the provider to the receiver (Sampson, 2000a; Sampson & Froehle, 2006). The necessity of using customers' input while creating the service is known as value cocreation. Value cocreation is defined as the process through which actors exchange resources and competencies to develop desirable capabilities in order to create value (Vargo & Lusch, 2004). Two opposing views exist in the literature: the widespread notion is that service is always co-created through interactions between service providers and service beneficiaries (Lusch & Nambisan, 2015; Michel et al., 2008; Sampson & Spring, 2012), and the other less common notion is that cocreation is an optional collaborative act between the provider and customer (Oertzen et al., 2018). I posit that cocreation is indeed an inherent aspect in care creation, but the type and degree of inputs that a patient provides vary significantly (e.g., unconscious patient in operating theater, patient in a therapy session with psychiatrist), which has different implications for healthcare OM. Additionally, although cocreation is inherent in all services, this process has unique implications in healthcare that should be considered while studying healthcare IT deployment, owing to the nature of these professional services. In the rest of the thesis, I use the terms "care creation" and "cocreation" synonymously as cocreation is inherent in the care creation process. I also use terms such as "service provider" and "receiver" in this thesis, which may seem inconsistent because the patients are also providers of different inputs in the service. However, even though they are collaborating to create care, the roles of patient and healthcare personnel are separable, as it is the patient for whom this care is being created. Therefore, the terms provider and receiver are used here to distinguish between these two groups in a simple way.

The dyadic division of receiver and provider falls short in explaining the complexity of the care creation process. The providers of care can be of many kinds, such as GPs, clinicians, nurses, physiotherapists, or nutritionists, whose roles and activities are different in creating care, which has major implications when the level of analysis is service operation, as it is in this thesis. While certain services are predominantly dyadic in nature, such as the consultation service, other services can involve multiple providers, such as a GP and municipality nurse. To avoid oversimplification, I have used the conceptual building blocks of cocreation offered by

McColl-Kennedy et al. (2012): based on social practice theory, the authors explained that cocreation can be comprehensively analyzed through the roles, activities, and interactions of the entities involved. The underlying theory is that value creation takes place in a social sphere and, as with all social practices, value creation can be understood by the roles played by those involved, and the way they interact with each other while conducting different activities. Roles, interaction, and activities influence each other and continue to shape the process in a cyclical manner (Kjellberg & Helgesson, 2007). The merit of these dimensions of cocreation is that they do not confine the analysis within a dyad of patients and providers and can be used to explain all kinds of care services. Thus, by using these dimensions, this thesis treats care creation as a multi-actor process and outlines the scope of studies, identifying the dominant actors for different care services.

Moreover, these dimensions allow us to study how the professional aspect of healthcare services influences different care creation processes. We can assume that, because of information asymmetry, the relationships between clinicians and patients or between clinicians and other healthcare personnel can be different to relationships in services where customers have clearer ideas of their needs and how to meet them. On the other hand, the autonomy and discretion of clinicians might influence the relationships between them and their management.

3.1.3 Routine and variation in care creation

Healthcare services require management of variation and at the same time must be reliable and safe. Maintaining stability while being responsive to variation adds complexity (Fichman et al., 2011). It is noteworthy that variation is treated as waste, and elimination of variation is considered as a means to increasing efficiency in the manufacturing industry (Schmenner & Swink, 1998), while in healthcare services, elimination of variation is to a great extent neither feasible nor desirable (Frei, 2006). The main source of variation in healthcare is patients; they have different diseases requiring different treatments, and they are diverse both demographically and economically. The variation that comes with the patients themselves cannot be eliminated, but is an integral part of the healthcare demand (Frei, 2006). Therefore, these services need to accommodate and manage variations by responding to them. Division of labor and specialization are managerial responses to variation, which consequently fragments healthcare services (Douma & Schreuder, 2008; Lillrank, 2012). The division of labor and specialization are attained by leveraging different types and levels of professionals in different departments, thus creating silos for different care treatments (Stabell & Fjeldstad, 1998). The fragmented silos have sequential or reciprocal dependencies on each other and, to create a wholesome care experience for patients, coordination among them is essential (Lillrank, 2012). Standard, schedule or plan, and mutual adaptation or feedback are the basic coordination mechanisms for any organization (March & Simon, 1958; Thompson, 1967). The first two, i.e., standard and schedule, can be framed under organizational routine or standard operating procedures where who does what and when is clearly established (Cyert & March, 1963a).

Routines are at the core of healthcare operations and play a significant role in ensuring the efficiency and quality of care (Greenhalgh, 2008). Some literature has considered that routinization and managing variation are two extremes of a continuum of how organizations solve problems and there is an inherent tension between them, i.e., routinization is possible for predictable tasks, whereas for variation in problems one needs to search for diverse solutions where routinization does not fit (Fichman et al., 2011; March & Simon, 1958). On the other hand, some literature has treated routine from a rather dynamic perspective, claiming that routine can provide stability and accommodate changes, which can explain how routine and sensitivity towards variation can co-exist in healthcare services (Feldman, 2000a; Goh et al., 2011; Pentland & Rueter, 1994). Accordingly, routine is not a single pattern of organizational activities, but a repertoire of possible patterns and the people in the organization can choose the most suitable pattern depending on the situation. Thus, routines in healthcare can provide stability and reliability while allowing for decision-making in various situations. Healthcare routines standardize activities to the extent it is possible in order to coordinate among different departments and professionals to create reliable and safe care services and lower risks. Additionally, standardizing certain tasks also conserves the cognitive ability of actors to make decision about activities that cannot be routinized (Greenhalgh, 2008). To summarize, routine helps to manage variation in two ways: by being a coordination mechanism between different care silos that are essentially created to manage variations efficiently and by standardizing the care creation activities as much as possible so that there is enough organizational capacity for making decisions for the uncertain, non-programmable activities.

IT deployment can create pivotal changes in healthcare routines (Barley, 1986; Edmondson et al., 2001; Orlikowski, 1992). IT deployment can either automate certain activities so they can be more standardized by establishing rules and protocols through different apps or platforms, such as EHR systems that impose a standard way of filling forms (Simon et al., 2007). This can increase the portion of routinized activities in the care creation process, leading to changes of roles and redistribution of work among different healthcare personnel. On the other hand, IT deployment can retrieve and provide new information about patients and treatments to reduce the uncertainty of the non-programmable activities and make them more standardized. For example, a CT scanner could provide more precise information by creating sharper images and facilitate decision-making. Sampson (2018) posited that IT systems can influence the professional's work in three ways: (1) augmenting, (2) down-skilling, and (3) automating (Sampson, 2018). To identify how IT deployment can influence the routines in care creation processes, the performative model of routine can be a useful lens because it theorizes why and how a routine can change and take a different pattern (Feldman, 2000a). This theory conceptualizes a routine as a cycle of plan, action, outcome, and ideal, and posits that when the outcome does not match the ideal after the actions are conducted as per plan, the actors in the organization change the routine. The mismatch between the outcome and the ideals can happen in four ways: the intended outcome is not achieved, an unintended and

undesirable outcome is produced, the outcome produces a new possibility, and the outcome falls short of ideals. Depending on the type of mismatch, the actors either repair, expand the routine or strive for new routine. In the light of IT deployment in healthcare, the actors are stratified in different groups with different levels of agency regarding changing their routine (Feldman, 2000b). Therefore, the roles the actors have influence the extent to which they can change the routine (McColl-Kennedy et al., 2012). Another complexity is to define the goal in healthcare services. As previously mentioned, a multi-actor perspective is crucial to explain healthcare service operations, and management, professionals, and patients may have different ideals or expectations of a service. Nonetheless, the performative model of routine is still valid in explaining how IT deployment can (or cannot) change the routines in care creation processes as long as the level and unit of analyses are predefined and clarified and consider the stratifications.

3.2 Healthcare performance

The OM literature on healthcare IT deployment is rife with performance attributes, from mortality rate to length of stay in hospital. The literature review article presents a comprehensive list of performance attributes used in the extant literature. These performance attributes are empirically measured and used as the dependent variables to identify how performance is correlated with different types of IT. In this thesis, healthcare performance is treated not as an empirical but rather as a conceptual entity. As the aim and the RQs indicate, the focus is not to measure the impact of IT on certain performance attributes, but to develop a generic understanding of the process of improving performance through IT deployment. Therefore, healthcare performance has been used as an aggregated term, i.e., a composite of several operational performance attributes, which may or may not be measurable empirically (Slack, Chambers, et al., 2004).

Generic OM performance attributes are cost, quality, dependability or reliability, speed or responsiveness, and flexibility or customizability (Meredith & Shafer, 2013; Slack, Chambers, et al., 2004). In service OM the service quality dimensions are identified as reliability, responsiveness, assurance, empathy, and tangibles (Parasuraman et al., 1991). For IT-enabled services, attributes such as integration quality, navigability, flexibility, site aesthetics, efficiency, and security have been used (Sousa & Voss, 2006; Zeithaml et al., 2002). Whereas the generic OM literature differentiates between quality and other attributes, such as reliability, responsiveness, and flexibility, from a service perspective these dimensions comprise service quality. The reason could be that in traditional OM, quality implies product quality, i.e., defects per unit, scrap level, etc. (Slack, Chambers, et al., 2004), which is less relevant for services. In healthcare management, quality of care is often used as an overall performance attribute that indicates two dimensions: access to care and effectiveness (Donabedian, 1988; Mosadeghrad, 2013). Access to care implies the availability of the care when it is needed, which is similar to responsiveness as defined by OM literature. Effectiveness implies both clinical effectiveness, i.e., the appropriateness of the application of clinical medicine to a health problem, and interpersonal effectiveness, i.e., the appropriateness of the

social and psychological interaction between patient and healthcare personnel—the ability to build trust, understanding, and empathy with the patient and to show sensitivity and responsiveness (Campbell et al., 2000).

In this thesis, I group these attributes into two dimensions—effectiveness and efficiency—which are also known as the voice of provider and voice of customer, respectively, in OM (Li & Benton, 1996; Sousa & Amorim, 2018). The effectiveness dimension encompasses all aspects associated with customers' or patients' experience, including the attributes of service quality and quality of care. On the other hand, cost is the dimension that is associated with different types of expenditure that are incurred by the service provider, such as healthcare facility, equipment, salaries etc. Effectiveness and efficiency together comprehensively conceptualize performance and have been used as the main dimensions of performance in the extant OM literature (Cho & Menor, 2010; Sousa & Amorim, 2018). To improve healthcare performance means either to improve the effectiveness of healthcare services in terms of responsiveness, customizability, empathy, flexibility, or reliability, or to improve service efficiency by reducing costs associated with capacity, personnel, equipment, etc. Effectiveness and efficiency are not necessarily mutually exclusive, particularly in public healthcare, because by reducing the cost of care or increasing capacity, the service becomes available to more patients in a timely way, thus increasing the quality of care (Institue of Medicine, 2001). In the context of IT deployment, both dimensions of healthcare performance are relevant. Service effectiveness and efficiency can be altered in many different directions as different types of IT are deployed in a healthcare organization. For example, application of sensors for monitoring patients can facilitate patient safety, improving the quality of care (Ruskin & Hueske-Kraus, 2015). On the other hand, the implementation of an integrated electronic system can lower the information processing cost, making the service more efficient (Li & Benton, 2006). Because RQ2 of this thesis explores if and how healthcare performance can be impacted by IT deployment, keeping an open perspective towards all attributes of performance by using aggregated dimensions of effectiveness and efficiency instead of pre-selecting certain attributes was deemed appropriate.

3.3 Characterizing IT deployment

The literature review study (Enam, Dreyer, Ingvaldsen, et al., 2022) conducted as part of this thesis indicates that most OM studies treat healthcare IT deployment in a deterministic way, i.e., the IT itself has the power to impact different organizational dimensions, which is called the imperative model of IT (Orlikowski, 1992). Another extreme that is opposite to the imperative model view is the strategic choice model, where IT is given no role in affecting organizational dimensions and is seen just as an instantiation of the human agents, organizational structure, and political and economic forces. None of these models provide a comprehensive view of IT deployment in an organization. While the imperative model used in OM literature ignores how the organization's structure, human agents, and wider context influence the IT deployment, the strategic choice model ignores the fact that IT deployed in an organization has some built-in characteristics that either enable or limit the activities

performed in the organization (Kellogg et al., 2020). To overcome these limitations, I conceptualize IT deployment following the structurational model of technology (Orlikowski, 1992).

The structurational model of technology posits that (1) technology is created by human beings based on the existing norms in society and the organization and with an intention to achieve something, but once created, technology is embedded with some properties or rules affecting the users and the organization; and (2) the relationship between technology and the organization is influenced by characteristics of the technology (e.g., its functional structure), characteristics of the human agents as designers and users of technology (e.g., their intentions and motivations), and characteristics of the context (e.g., task structure, resource allocation) (Orlikowski, 1992). The first aspect of the model provides insight into the scope of the technology, i.e., what it is comprised of, and the second aspect focuses on the role of technology once deployed in an organization.

The scope of IT is basically to automate and informate in order to accomplish one or more of the following interdependent operational objectives: to facilitate continuity—functional integration, enhanced automaticity, rapid response; to facilitate control—precision, accuracy, predictability, consistency; to facilitate comprehensibility—visibility, analysis, synthesis (Zuboff, 1988; Zuboff, 2019). As the structurational model posits, to what degree and how IT can accomplish these objectives are inscribed in the IT as it is designed, which I refer to as the functionality of IT in this thesis. Depending on the functionality, IT influences the users and organizations. However, at the same time, the users and organizations influence how the IT is deployed in the organization and applied in work processes by users. Thus, IT deployment is a situated phenomenon: the employees in an organization do not merely receive the IT as it is, but rather adapt and include it into existing work processes to varying extents (Leonardi, 2013; Markus & Silver, 2008). This is known as interpretive flexibility and is a crucial aspect to consider while studying IT deployment (Mutch, 2010; Orlikowski, 2000). However, the extent to which IT is flexible for different interpretations and applications varies from technology to technology (Orlikowski, 1992). For example, the computed tomography (CT) scanner studied by Barley (1986) has less scope to be interpreted or used in different ways compared with an EHR system that has multiple functions and alternative ways of performing the same function. The functionality of IT affects the degree of interpretive flexibility it has, which means it is important to avoid the black box treatment of IT and be explicit about the functionalities of the IT being studied (Bal et al., 2022; Orlikowski & Iacono, 2001).

Therefore, in this thesis, IT deployment is seen as an occasion of change that influences how people in healthcare organizations carry out care delivery processes. On one hand, by looking at the task-level variations triggered by IT deployment, this research aims to explicitly demonstrate the changes triggered by IT deployment; on the other hand, by considering the contextual conditions, such as organizational structure and ownership, it aims to explain the reasons for these effects (Bailey & Barley, 2020). Both the functionalities of IT and its

interaction with the users situated in a particular organization are thus important considerations for this thesis.

3.4 Context

Context is the inner and outer situation of an organization on several levels and understanding context helps us to explain why something is happening in the organization under study (Pettigrew, 1987). Although the importance of accounting for context while conducting research is frequently mentioned, context-based research is not so evident and the OM literature does not clarify how it can be achieved (Meredith, 1998; Williams & Radnor, 2022). In this thesis, context can be defined on many levels. I focus on the context with the aim of differentiating the area of this research from other areas, so that the analysis and interpretation of the empirical material are reasonable and valid. For example, from a macro perspective, service and manufacturing contexts are different and they demand distinct treatments, e.g., the cocreation lens is more appropriate for the former. Similarly, healthcare service is an even more specific context in which the professional lens is more appropriate than in retail services. At another level of analysis, primary and specialized healthcare can be treated as two distinct contexts, as can public and private healthcare. The importance of these differentiations varies depending on the aims and RQs of a study.

For this thesis, the context is public healthcare including both primary and specialized care. Like other public services, in public healthcare, the customers, i.e., patients, do not directly pay for the service, which makes the concept of value creation or performance more perspective dependent than in the private sector (Radnor & Osborne, 2012). There is little to no opportunity to influence demand in public healthcare, re-using freed up resources is very difficult, and capacity is mostly fixed by political bodies. Therefore, demand and capacity management are more challenging than in the private sector (Ritchie & Walley, 2016). Lastly, public healthcare needs to place equal importance on effectiveness and efficiency, and it is expected to achieve both simultaneously (Osborne et al., 2013). The context has played an important role in choosing (and eliminating) different theoretical concepts. The examples of choosing cocreation and professional service lenses are given above. One example of a theory that does not fit the context of this study is from the multichannel (MC) service literature. In the extant literature, the voice of the channel user is a singular voice of the customers because they choose the channels, whereas in the remote channel consultation service, as elaborated in the fourth article of this thesis, both clinicians and patients can choose the channel for consultation. Overall, the element of context was never at the forefront of this thesis but has been considered continuously while designing the research and analyzing the empirical material and explaining the findings.

This chapter briefly describes the concepts and the theoretical frameworks that have been used in the thesis. To delve into the problem statement of the research and address the RQs, identification of literature that is rigorous as well as fitting to the context was essential. The characterization of healthcare service operations has played an important role in choosing the

thesis's concepts and frameworks, such as literature on professional service organizations, cocreation, and organizational routine. On the other hand, the research framework (figure 1) has guided the choice of the structurational model of technology as the lens through which to analyze IT deployment. Overall, the aim was to compile a body of literature that can facilitate understanding and explaining the complexities of the phenomena under study.

4. Methodology

As mentioned earlier, this thesis comprises four articles that contribute to answering the RQs. However, the thesis also extends the findings of the articles addressing the problem statement and overarching aim. This chapter briefly explains the overall research design and the collection and analysis of empirical material in general. The detailed research design and methodology employed in different articles can be found in the papers attached at the end of the thesis.

4.1 Research design

The thesis was designed as a multiple case study in which the deployment of two different IT-enabled services, namely remote consultation (RC) and distance monitoring (DM), were studied. The case study is a suitable research method when the aim is to (1) study a contemporary phenomenon in its natural setting (Yin, 2018); (2) explore how different processes in organizations unfold over time (Bluhm et al., 2011); (3) develop new constructs to deepen the study of a comparatively new phenomenon (Benbasat et al., 1987); and (4) answer how and why a phenomenon develops or extend theories from the patterns of relationships of the constructs recognized in the case (Eisenhardt, 1989). As this research aimed to understand and explain the process of IT deployment in healthcare organizations in terms of changes in the care delivery processes and the implications on healthcare performance, rather than describe and measure the effect of IT deployment on performance, the case study was deemed appropriate for the thesis.

In particular, a multiple case study design facilitates comparisons clarifying the circumstances under which the findings can be expected to be repeated (or not), and makes the findings more robust as they are analyzed in various empirical settings (Eisenhardt, 1989; Yin, 2018). Bearing these benefits in mind, this study was designed to study two different IT-enabled services that have some common as well as some distinctive features, as discussed later (in section 4.2). The purpose of using two case studies was to identify to what extent the mechanisms that lead IT deployment to alter performance vary from service to service and whether there are common patterns in these mechanisms.

The unit of analysis should be such that the phenomenon of interest is empirically observable (Yin, 2018). Because the focus of the study was on the interaction between care creation processes and IT deployment, it was necessary to observe how IT deployment affects the tasks and operations within the care delivery process and, therefore, the unit of analysis is the service operations in the care creation process. It is notable that the terms “care creation process” and “care delivery process” are used interchangeably in this thesis because the delivery and creation of care are simultaneous in the definition of service. Similarly, creation implies cocreation because service is always co-created by both the provider and the receiver of the service (Grönroos & Voima, 2013; Lusch & Nambisan, 2015; Sampson, 2000b).

4.2 Case selection

Selection of cases is crucial within the case study design and the aim is to select cases where the focal phenomenon is likely to be present and some similarities and differences across cases are likely to occur (Eisenhardt, 2021). To answer the RQs, the study required cases where the IT was being deployed on a larger scale, as opposed to a pilot project or clinical randomized trial. Without an organization-wide deployment, the changes in ongoing service operations could not be identified. Therefore, IT deployments that had passed their experimental phase and were becoming part of the ongoing organizational routine were suitable for this study. On a practical note, the cases had to be located in the vicinity of the researcher so that close contact could be developed and maintained between the cases and researcher (Barley, 1990). In summary, the criteria used for case selection are as follows:

1. Two or more similar IT-enabled services
2. Services being deployed organization wide as opposed to being tested in a pilot project
3. Services that are easily accessible so empirical material can be collected with minimum constraints

The DM and RC services fulfilled all three criteria and thus became the two cases of this research. Both services are within telemedicine and have enough similar features to make the cases comparable and enough distinctive features to identify them as two different cases. For example, both services mitigate the need for in-person meetings between the care provider and the patient by providing distance care, but in DM, patients need to upload health data, which is not the case for video consultations (VCs). Furthermore, each service has a different group of healthcare personnel as the core user of the IT, namely, municipality nurses and clinicians, and they have different healthcare settings, namely primary and specialized healthcare, respectively. Both services had passed their trial phase, had organization-wide presence, and were accessible for data collection and formal/informal inquiries during the study period.

These two cases were used as representative or typical cases to allow the consideration of commonplace situations as opposed to unique or critical incidents (Yin, 2018). Therefore, data for each case were collected from multiple sources (source triangulation; see (Bryman, 2008; Patton, 1999), i.e., we examined the same service provided by different units or organizations to ensure that data represented the typical DM service and typical RC service in Norway. For the DM service, three municipalities of different population sizes were invited to participate in this study and two of them (the medium and the small ones) agreed, while the other declined because it did not have enough manpower to spend time on this research activity. For the RC service, six clinics in one of the largest public hospitals in Norway were invited and three of them agreed to participate in this research. The cases are briefly discussed below. It is worth noting that the two cases are the DM service and the RC service, whereas the two municipalities and three clinics were data collection sources for these two cases, respectively.

4.2.1 Case of the distance monitoring service

The DM service is offered by the municipality as a part of primary healthcare in Norway. Originally a trial project in 2008, DM has become a regular service as a part of welfare services, and around the time this study was conducted, four municipalities were providing this service (Das et al., 2018). The service is based on a DM app used by patients to upload their health-related data by filling in predesigned forms and to write messages or questions. These data are then monitored by a group of nurses in a monitoring center in real time. When the data indicate the worsening of a health condition—a deviation from the preset threshold value of health parameters—a nurse contacts the patient and suggests a change in medicine or dosage, depending on the treatment plan predesigned by the patient's GP. This service is directed towards elderly patients with chronic disease, such as chronic obstructive pulmonary disease, heart failure, diabetes. The aim of the service is to keep the patients functioning well for as long as possible, delaying the need for institutional care by providing proactive support as required.

4.2.2 Case of the remote consultation service

Following the government's mandate to use VCs to (1) reduce the cost of healthcare, in particular the cost of patients traveling to and from hospital for in-person consultations (PCs), and (2) make the consultation service easily accessible to patients by reducing the time spent (Ministry of Health and Care, 2019), the hospital that participated in the study started to introduce VCs among clinicians at the beginning of 2019. Initially, only a few clinics were invited to start VCs as an alternative to PCs. Later in the year, all clinics were asked to use this service. However, VCs were seldom in use in the hospital until the outbreak of Covid-19 followed by the nationwide lockdown in March 2020. During this time, clinicians were left with no option other than VCs, as only patients with emergency conditions were allowed to visit the hospital.

4.3 Data collection and analysis

A qualitative method was used to collect data in both cases. Identifying the key informants for each case and meeting them to make a data collection plan were the preliminary steps in the data collection. As in most qualitative studies, data collection was a continuous process from 2019 to 2021 and overlapped with the exploration of theories, data analysis, and reformulation of the RQs (Bryman, 2008). The relation between theory and data was neither inductive not deductive, but rather abductive (Dubois & Gadde, 2001). There were several iterations between these processes that did not follow a linear path from theory to data or vice versa. The semi-structured interview was the main data collection method and this was complemented by non-participatory observation and archive data from different public documents and meeting notes.

Following Yin's (2018) case research method, two case study protocols were developed for the two cases, which included the primary RQs and interview guide. The interview guide consisted of an elaborated set of questions for each group of actors involved in the care

delivery process, for example, clinicians, GPs, patients, nurses, administrators, managers. The interview questions covered aspects connected with the unit of analysis, i.e., care creation activity. Attention was paid to capturing these activities performed both with and without using the IT so that the tasks added, changed, and omitted in the IT-enabled service could be easily identified. The case study protocols were then submitted to the Norwegian Center for Research Data and Regional Ethical Committee to obtain ethical approvals to conduct the research as designed. Data collection commenced upon approval by both committees. Both services were studied for more than two years to capture the natural way of doing things in the care delivery processes. Table 1 provides an overview of data collected in the semi-structured interviews.

Table 1: A brief overview of data collected through interviews

Case (data collection period)	**Informant type (number of informants)**	**No. of interviews**	**Average duration of interview (minutes)**	**Used in**
1. Distance monitoring (fall 2019–fall 2021)	Municipality nurse (10)	11	60	Article 2: Impact of DM service in managing healthcare demand: A case study through the lens of cocreation
	General physician (3)	4		
	Manager in welfare technology (4)	6		
	Manager of human resources (2)	2		
	App developer (1)	1		
	Patient (1)	1		
2. Remote consultation (fall 2020–fall 2022)	Clinician (16)	29	60–75	Article 3: Individuals' perceptions as a substitute for guidelines and evidence: Interview study among clinicians on how they choose between PC and RC Article 4: Designing RC services for hospitals
	Patient (20)	20	30–40	
	Manager (7)	7	60	
	Nurse (3)	3		
	Administrator (3)	3		

Interviews were audio recorded and transcribed. The data analysis process can be divided into steps: (1) scrutinizing the empirical material collected from interviews and notes and (2)

interpreting them through theoretical lenses. The first step was somewhat similar for all three empirical articles, where descriptive coding was used to categorize the empirical material into manageable groups (Miles et al., 2014). This process aided in refining the research framework and questions of each article. Next, the dimensions of the research framework were used as the lens to identify the themes within the data groups. Lastly, pattern coding was applied to identify the trends or recurrence of similar themes, and explanations of recurrences were sought using relevant theories (Eisenhardt 1989). The articles can be referred to for the detailed data analysis processes.

Besides the interview data and archive data, I used secondary data (Bryman, 2008) in the DM case. Owing to Covid-19 restrictions, only one patient was interviewed in relation to this case. Because the patients in this case were elderly, digital interviews were not considered appropriate and an additional ethical approval would have been needed to change the study design. Therefore, the content of a project report was used to include patients' voices in this case. The aim of the report was to identify patients' perceptions and experiences of the DM service, which aligned with the aim of the interviews originally planned in the case study protocol. We undertook several precautions to ensure the quality of the data: (1) to minimize researchers' bias, direct patient feedback was used, instead of the report's analysis; (2) the data were collected in late 2019 and early 2020, overlapping with our data collection period; and (3) one of the authors of the report, a nurse, was interviewed to understand the context of the data collection and the types of questions asked.

4.4 Validation and limitation of applied methodology

4.4.1 Ensuring research quality

The quality of a qualitative research study can be assessed across different dimensions, namely, replicability, reliability, internal validity, and external validity (Bryman, 2008; Miles & Huberman, 1994). Replicability refers to whether all the steps taken to conduct a study are objectively documented so that it can be replicated by another researcher; reliability refers to whether the measures used to represent concepts in a study are consistent; internal validity refers to whether the conclusions made from a study are justifiable within the realm of the study; and external validity refers to whether the conclusions can be generalized beyond the specific context of the study. To ensure replicability of these studies, the methodological decisions taken to conduct this research and the communication of those decisions were major considerations while writing the articles for this project. The procedures of applying for and receiving approvals from two ethical committees played an important role in designing the studies in as much detail as possible, and the protocols were conformed with until the end of the studies.

Reliability and internal validity are directly connected with conceptual coherence and anchoring the study with sound theories. Applying consistent concepts, collecting data that represent the constructs of the chosen concepts, and analyzing the data to explain the relationships between those concepts can ensure the reliability and internal validity of a study.

To align the studies with these steps, I used established theories such as the value cocreation cycle (McColl-Kennedy et al., 2012), performative model of routine (Feldman, 2000a), and task-technology fit (TTF) model (Goodhue & Thompson, 1995) as the research frameworks in the studies. All these frameworks have actor and task elements as their constructs, which is aligned with our empirical query of identifying interaction between IT deployment and the care delivery process. Additionally, the results of both case studies were presented to the practitioners at different points of the studies to check whether the empirical materials were understood in the right context and the conceptualizations of the empirical situations were reasonable and justifiable. For the DM service case, one of the GPs and one of the managers of the welfare technology participated in a seminar at Norwegian University of Science and Technology (NTNU) where I presented the empirical paper written on this case. For the RC case, I presented some of the findings during the data analysis period of the third paper in a seminar arranged by the hospital, and the findings of the fourth paper were presented in two different seminars, one to the clinicians (n = 20) and one to the managers (n = 8). There was a discussion session at the end of each seminar where practitioners asked questions and shared their opinions about the findings.

With regard to external validity, a differentiation to be made between theoretical generalizability and statistical inference because only the former is pertinent to qualitative research and hence to this thesis (Bryman, 2008; Yin, 2018). Theoretical generalizability is about how well and to what extent the conclusion drawn by a research study can explain the phenomenon of interest, rather than how widely the conclusion can be applicable. Therefore, the focus of the articles was to explain the inconsistencies that appeared in the study with the help of existing theories (e.g., articles 1, 2, and 3), and argue for a better design of the service that can lead to better performance (e.g., articles 2 and 4).

4.4.2 Navigating the Covid-19 pandemic

Owing to the Covid-19 pandemic, the data collection plan was delayed for three months, and secondary data were included in one case. Additionally, the pandemic and the restrictions it brought to society impacted both the services I investigated. The research design and RQs were not formulated for such a disruptive phenomenon. Hence, a choice had to be made on how I positioned my research in relation to the pandemic. It was clear that I could not deny or avoid this occurrence because case studies are all about the real context, and the pandemic was real and coexisting during the period of this research. I was left with two alternatives: (1) make Covid-19 an object of research and investigate its effect on IT deployment and vice versa, or (2) consider Covid-19 as a part of the context and treat it as an element that affects what I am studying but stays in the background. As a PhD is a time-bound process, the first alternative seemed to be less attractive because it required changes to the RQs and probably the research design. Moreover, that alternative would have led to studies and publications revolving around a one of a kind cases, contrary to the original focus of this thesis. Therefore, I chose the second alternative and treated the pandemic as a contextual element. My challenge was then to make sure that the influence of the pandemic was neither downplayed nor

exaggerated. I endeavored to address this challenge by adhering to the empirical data and identifying explanations for the data that were theoretically sound and grounded in the current context. Nonetheless, I believe the empirical situation would be quite different in both my cases without the pandemic. For example, the hospital may not have had as many RCs and I would not have found as many informants who had experienced RCs, either as patient or clinician. Additionally, the DM service would have implemented an advanced version of the app with new functionality that would have changed the tasks for the nurses and the patients.

4.4.3 Suitability of the research design

The rigor and merits of case study research to develop and extend theories is well documented in OM literature (e.g., (Ketokivi & Choi, 2014; Meredith, 1998; Voss et al., 2002). Another related topic often discussed in this field is whether, as a field, OM lacks in applying and creating theories (e.g., (Schmenner & Swink, 1998; Walker et al., 2015a). Recent research has indicated that the rapid development of IT and other social disruptions in finance and the economy provide a novel opportunity to advance the OM scholarship, but existing theories may fall short of explaining these novel situations (Lev & Shen, 2015). Systematic reviews of healthcare OM literature from 1982 to 2020 have revealed that the theoretical contribution made by this domain has been inadequate (Dobrzykowski et al., 2014; Enam, Dreyer, Ingvaldsen, et al., 2022). Interestingly, these reviews have also demonstrated that less than 30% of the literature used case study research designs. Clearly, more case studies are required to advance healthcare OM as a relevant and rigorous field of research. This thesis is a step in that direction and, in this way, it has managed to show that OM can substantially contribute to generating new insights on IT deployment.

In retrospect, I find the multiple case study design was appropriate for this research. The other alternative methodologies, such as experiment or surveys, would not have allowed me to gather the type of data needed to explain the phenomenon in depth, which was required to address the aim. Additionally, the case study design is appropriate to study a phenomenon in its natural setting and to provide explanations for a comparatively novel phenomenon where the theoretical concepts and variables are underdeveloped (Benbasat et al., 1987; Bluhm et al., 2011). Additionally, such a design provides researchers with the opportunity to choose and apply theories as and when needed, which is essential for explorative studies, such as this one (Bryman, 2008). The continuous iteration between theory and empirical material allowed me to refine the outcomes of this research, which could have been limited had I chosen another research method. Lastly, the case study design made it possible for me to develop and maintain resourceful relationships with the case organizations until the very end of the project, which enriched the quality of empirical material.

However, there are two points to make. First, a longitudinal case design could have been even more appropriate for the thesis, and the cases were followed for two years with the aim of identifying some longitudinal elements, i.e., evolution/changes happening in the time. However, I could not find such elements. I suspect that one of the reasons could be that the

pandemic had broken the data collection period into many small periods of slightly different contexts (pre- and post-lockdown, and wide ranges of restrictions within the lockdown period) limiting a natural progression of the services.

Second, I found that the stringent ethical and safety requirements of healthcare research that includes patients as respondents put some limitations on the qualitative case study. Unlike in randomized clinical trials—the gold standard of medical research—it is difficult, if not impossible, to clearly define the variables, their measures, and the objective of the study at the inception of a qualitative case study. In case studies, the researchers are in a state of exploration, at least at the beginning of the study (Locke et al., 2008). In order to get approval for data collection, it was required to provide a study design that included whom I would interview, the number of interviews, and interview questions. This, in a way, set a boundary for my research at quite an early phase when I had not figured out exactly what I was looking for. Additionally, because of the sensitive nature of the service, I was not able to observe the care giving processes, which could have provided insight for answering the RQs. While the ethical protocols are there to safeguard patients' wellbeing, which I also hold as the highest priority, and these protocols were supportive in defining the study design clearly, they also limit the scope of exploiting the flexibility of the qualitative case study design.

5. Summary of independent articles

The four articles that constitute this PhD project are briefly discussed in this chapter. Table 2 presents the article titles and their current status.

Table 2: Current status of the articles comprising the thesis

Article	Current status
1. Improving healthcare operations with IT deployment: A critical assessment of literature and a framework for future research	Published in 2022 in *International Journal of Healthcare Management and Technology*. doi:10.1504/IJHTM.2022.10051288
2. Impact of distance monitoring service in managing healthcare demand: A case study through the lens of cocreation	Published in 2022 in *BMC Health Services Research*. https://doi.org/10.1186/s12913-022-08164-2
3. Individuals' perceptions as a substitute for guidelines and evidence: Interview study among clinicians on how they choose between in-person and remote consultation	Published in 2022 in *JMIR Formative Research*. doi:10.2196/35950
4. Multichannel consultation service design in hospitals: Implications for service efficiency and effectiveness	Under review in a journal since May 2023

Figure 2 shows how these articles have contributed to answering the RQs and the problem statement. The first article is a systematic literature review conducted at the initial stage of this PhD study where the general aim was to understand the latest research on IT deployment in healthcare OM. Through this article we created an inventory of healthcare IT deployment research in the OM discipline and refined our understanding of research gaps in this field. Thus, along with the problem statement, this article played a significant role in shaping the RQs.

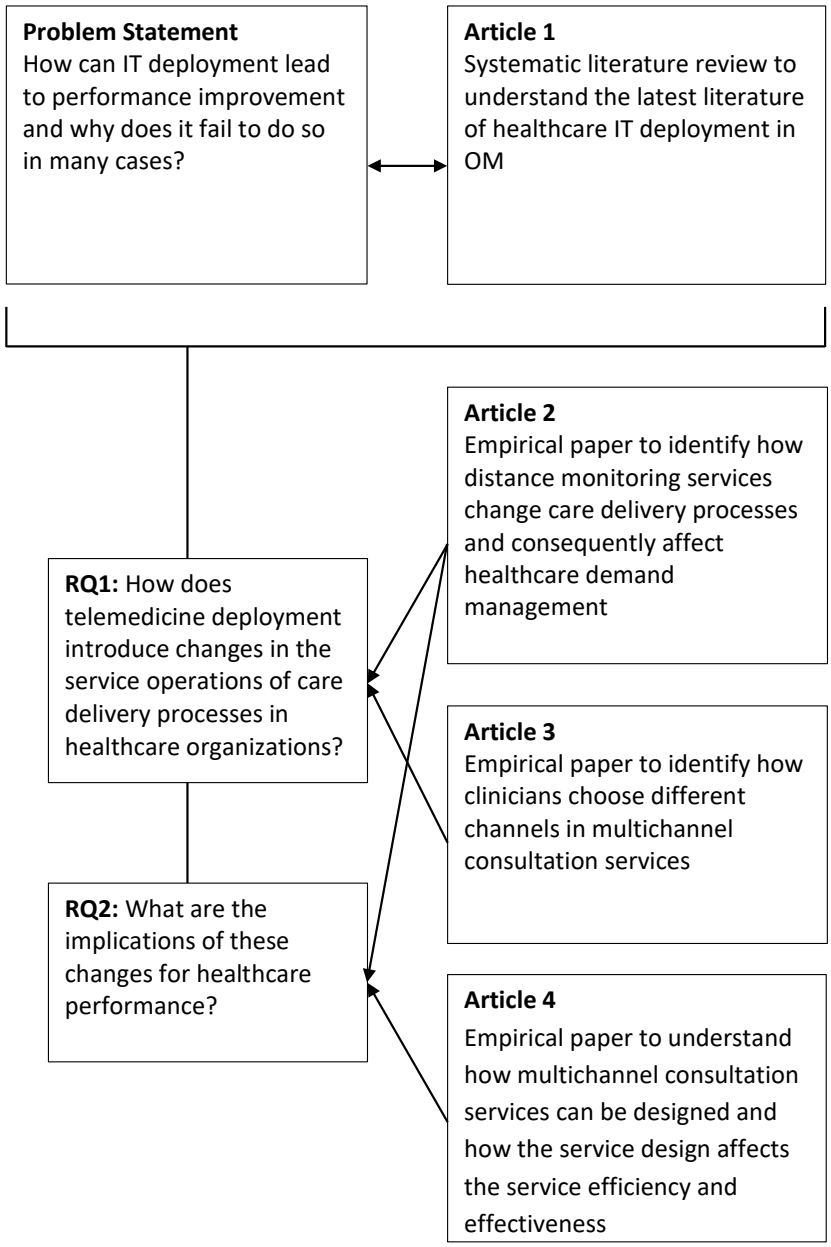

Figure 2: Connecting the articles with the RQs and problem statement

The other three articles are empirical studies where article 2 corresponds to the DM case and articles 3 and 4 correspond to the RC case. The objectives of these articles are similar to the RQs, i.e., to identify the changes triggered by the DM and RC services in the respective care delivery processes and their implications for performance in the respective organizations. Article 2 addresses both RQs for the DM case, whereas articles 3 and 4 address the first and second RQs, respectively, for the RC case. Thus, the empirical articles answer the RQs for the

deployment of two different types of IT in two different healthcare organizations. A brief summary of the four articles is provided below.

5.1 Article 1: Improving healthcare operations with IT deployment: A critical assessment of literature and a framework for future research

5.1.1 Objective

This was the first article to be written in this PhD project. The purpose of writing this paper was to develop an in-depth understanding of the latest literature pertinent to my research, so that the research gap could be identified and eventually addressed through the subsequent papers. The aim of the article was to (1) assess how literature on healthcare OM has explored the influence of IT deployment on healthcare performance and (2) propose how to enhance the pragmatic knowledge on improving healthcare performance with the support of IT. An analytical framework was developed based on CIMO logic to guide the study. The following RQs resulted from this framework:

1. How has IT deployment been studied in relation to performance of the healthcare system?

1.1 How is context taken into consideration in the studies?

1.2 How have the studies conceptualized IT deployment in healthcare?

1.3 What are the performance attributes and other variables influenced by IT deployment?

1.4 What are the theories or mechanisms that emerged or were tested in the studies?

2. How can future research within IT deployment and healthcare performance be more effective in generating pragmatic knowledge?

5.1.2 Methodology

A systematic review of the literature was deemed appropriate to answer the RQs. We followed the review steps outlined by Tranfield et al. (2003), as they were designed for reviewing the literature from management studies (Tranfield et al., 2003). We additionally applied the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework (Liberati et al., 2009) to facilitate identification of relevant articles when conducting the review. PubMed, Scopus, and Web of Science were the search databases. Only papers published in scientific journals were included and no limit was set for the publication year. The earliest and latest papers included were from 1992 and 2020, respectively. We identified and critically assessed 97 studies for this article.

5.1.3 Findings

This review study identified that, in the current literature, IT deployment and healthcare performance are often conceptualized as black boxes, being related to each other as input and output; existing theories inadequately explain the phenomena, and emerging theories are

lacking, which restricts the identification of the underlying mechanisms in the IT–performance relationship; and contextual factors, such as size of organization, public or private ownership, primary or specialized care, are often overlooked. These issues have limited the generation of pragmatic knowledge on IT deployment in healthcare. A framework has been developed, arguing that to overcome these limitations, future studies should do the following: (1) conceptualize IT in terms of its functionalities; (2) explain the reason(s) for selecting the performance attribute(s); (3) identify the mechanisms of the IT–performance relationship by analyzing the consequences of IT deployment on service operations; and (4) consider the contextual factors while explaining the IT–performance relationship.

5.1.4 Contribution

The study contributes by devising a framework for future research to advance knowledge on healthcare OM. The guidelines argue that the changes in service operations triggered by IT deployment are a key element in understanding how IT deployment can improve healthcare performance. Therefore, these changes should be analyzed in relation to IT functionalities, rational performance attributes, and contextual factors in order to develop pragmatic knowledge. Moreover, this study clarifies how OM, being an applied field, can contribute to extending existing theories and develop new theories about technology management in healthcare. Current studies are appropriate for making predictions in the form of hypotheses that set out to measure variables, whereas theory development requires causal logic in the form of propositions that involve concepts (Whetten, 1989). Although existing studies can answer the questions of *what*—and partly *how*—our framework can help answer the question of *why*, which is a fundamental aspect of theory building (Meredith, 1998; Sutton & Staw, 1995; Wacker, 1998). Once studies begin to identify the relevant mechanisms underlying IT deployment and performance, the extension of existing theories and emergence of new theories will become more frequent, which will increase OM's relevance in IT studies.

5.2 Article 2: Impact of distance monitoring service in managing healthcare demand: A case study through the lens of cocreation

5.2.1 Objective

The aim of the paper was to explore how DM services can affect demand and capacity management in healthcare. The objective of the paper was to identify (1) how DM services change the care delivery process and (2) how these changes can potentially improve the management of demand and capacity in healthcare. Based on service cocreation concepts and the literature on demand and capacity management, a research framework was developed that guided the data collection and analysis processes.

The RQs of the paper were as follows:

1. How do DM services change the care delivery process?

2. How do these changes in the care delivery process affect demand management in healthcare?

5.2.2 Methodology

A qualitative case study was conducted in which the DM service was the case in which the care delivery process was the unit of analysis. Data were collected from two municipalities to typify the DM service. Data were collected mainly by interviewing municipality nurses, GPs, managers, and the DM app developer. Secondary patient data were collected from a study conducted to evaluate the DM project. Archival data collected from public documents and project reports were used for data triangulation. The deductive content analysis method was used to analyze the data, i.e., predefined dimensions derived from the theoretical framework were used for data categorization at the initial stage.

5.2.3 Findings

This study found that the application of the DM service changes the care delivery process by creating new activities, new channels for interaction, and new roles for patients, GPs, and nurses. We defined patients' roles as proactive providers of health information, GPs' roles as patient selectors, and nurses' roles as technical coordinators, data workers, and empathetic listeners. To deliver care in the DM service, patients' participation in the care cocreation process must be increased. Patients are required to measure and provide health data to initiate the service, which is not required for traditional services. Additionally, the DM app becomes a new channel of interaction between patients and nurses. On the other hand, GPs need to identify the right patients for this service. The health condition, ability to measure health data, and technical skills vary from patient to patient. Not all patients are suitable for the DM service. Therefore, the GPs need to identify which patients are most suitable for this service, which is a novel task for them. Lastly, the municipality nurses embark on three new roles: coordinate separately with patients and GPs, solve patients' technical issues, and develop the ability to empathically respond to the patients via telephone calls.

We identified that the cocreation aspect of the care delivery process becomes more significant in the DM service, which demonstrates some new potential for better healthcare demand management. Demand management strategies, such as increasing client participation, segmenting and rechanneling clients, having a multiskilled and flexible workforce, were identified to be applicable in the DM service. However, because the DM service requires increased patients' participation and closer coordination and collaboration among GP, nurses, and patients, this service simultaneously adds complexities to the management of the care delivery process. To reduce the complexities, we proposed three mechanisms: foreseeing and managing new roles, developing capabilities, and adopting a system-wide perspective. Put simply, we argued that it is essential to acknowledge and formalize the changes in the care delivery process triggered by the DM service. Consequently, the service needs to be designed according to those changes so that the potential of DM identified in this paper can be actualized and the risk of over-consumption of resources can be minimized.

5.2.4 Contribution

This paper pinpoints the importance of analyzing operational changes that are triggered by IT deployment, the DM service in our case, which is under-explored in the current literature. The merit of such an analysis is that it provides a comprehensive understanding of the managerial aspects of telemedicine that are essential for applying IT for better service configuration and improved care. The identified new roles and managerial mechanisms provide a means for managers to reflect on their planning and decision-making regarding telemedicine implementation. Often, healthcare organizations, as in our case, introduce telemedicine services hoping that they can reduce resource consumption. This study shows that telemedicine can facilitate certain strategies, but that managerial actions in designing telecare services remain pivotal in addressing the escalating demand with limited resources. This paper empirically shows why managerial actions, such as service design and planning, are crucial to improving healthcare performance through IT deployment. Without recognizing operational changes and providing anchors to support those changes, IT deployment cannot do much, if anything, and may even adversely affect resource consumption and quality of care. Finally, we draw policymakers' and practitioners' attention to the need for new competencies and training to develop these competencies, which are essential for large-scale implementation and use of telemedicine as a regular service as opposed to pilot projects or interventions.

5.3 Article 3: Individuals' perceptions as a substitute for guidelines and evidence: Interview study among clinicians on how they choose between in-person and remote consultation

5.3.1 Objective

This study aimed to thoroughly investigate how clinicians determine their choice of different consultation modes, namely, PC, VC, and telephone consultation (TC). Because clinicians have the most powerful voice in deciding the fate of a technology in healthcare organizations, it is crucial to identify clinicians' reasoning for choosing (or not choosing) remote channels to predict the future of RCs. This paper applied the performative model of routine (Feldman, 2000a) as the theoretical lens, because studying IT implementation from a professional's routine perspective can provide a better understanding of the long-term applications of IT (Nadav et al., 2021). In order to understand how clinicians choose between different consultation types, it was important to analyze their routines in depth, which was done using this theoretical model. According to the performative model of routine, routines are not fixed actions performed by the people in an organization; rather, they are dynamic patterns stemming from ongoing exchanges between ideals, plans, actions, and outcomes. This model was used to frame how clinicians make sense of the implementation and continuation of the large-scale application of VC, along with TC and PC, in hospitals. The RQ of the study was:

1. How do clinicians choose the consultation type from among PCs, VCs, and TCs?

5.3.2 Methodology

A qualitative case study was conducted where the consultation service was the case and the unit of analysis was the clinicians conducting the consultations. We interviewed a group of clinicians (n = 16), of whom 13 were interviewed twice, advisers of the research and development center responsible for facilitating VC implementation (n = 7), and patients (n = 16). The interviews with the clinicians were the primary data source of this paper, whereas the other interviews, archival data, and observation notes from a workshop were used to enhance our contextual understanding and for data triangulation. Deductive content analysis was used to analyze the data, i.e., the dimensions from the performative model of routine were used to categorize the data.

5.3.3 Findings

First, we identified how clinicians' routines are affected by RCs by using the theoretical framework including the plan, ideals, action, and outcome aspects of the consultation routine. In total, six different planning criteria were identified, and individual clinicians used different combinations of these criteria when choosing a mode of consultation. The criteria are: need for physical examination; whether TC would be more efficient than VC (technologically simpler or due to the availability of equipment); whether VC would be more efficient than TC (because patients can be seen); distance from the hospital for the patient; patient's ability to use VC; and whether TC or VC adds flexibility to the clinician's work.

The ideals that clinicians hold for conducting consultation relate to ensuring the right diagnosis, right treatment, communication and conversation with patient, safe and comfortable consultation, and less intrusive consultation. The clinicians' understanding of how these ideals are changed by the application of RCs varied noticeably. Some thought RCs could lower the quality of care by risking the right diagnosis and treatment. Some thought that the interpersonal aspects of a consultation, such as small talk, greetings, trust, are less nurtured in RCs than in PCs, which again could hamper the quality of care. On the other hand, some posited that RCs are more easily accessible and could facilitate less intrusive care, because the patient spends less time and energy on their treatment. Lastly, some also pointed out that the flexibility of RCs could increase the hospital's capacity, which would reduce waiting times and improve the quality of care. The other two aspects of consultation routine, i.e., tasks and outcomes, were not majorly impacted by RCs. The few tasks that have been added as a part of consultation activities, such as connecting to Skype and asking patients about their preference for consultation types, had minor effects on clinicians' routines. On the other hand, no change of outcome has been visible to date.

The paper shows that the ways clinicians choose the consultation type in their daily routine vary to a great extent and it is not possible to put forward a single chain of reasoning that can justify all the choices they make. This paper therefore posits that, when the objective of an IT implementation program is not directly aligned with clinicians' ideals for a certain healthcare service, they do not immediately welcome the implementation, even if the IT does not

threaten their professional autonomy or complicate their existing routines. Instead, they seek reasons to dismiss or adopt it. In these situations, if there is insufficient evidence or uniform understanding of the benefits and harms caused by the IT, the professionals rely on their individual judgment and personal preferences to decide how and to what extent they adopt the IT. Thus, diverse opinions emerge, including some paradoxical ones, resulting in an uncertain future for sustainable large-scale implementation of IT in healthcare.

5.3.4 Contribution

This paper provides an explanation for the low number of large-scale IT adoption and sustainable implementation projects in healthcare organizations by thoroughly analyzing how and to what extent clinicians use technology to conduct consultations. Literature on clinical efficacy of RCs is rife and the literature on the management of such consultation services is also on the rise. However, no other study to date has provided a detailed picture of how clinicians navigate their choices and make decisions for these consultations. Moreover, this paper indicates several aspects that impact the implementation of IT in healthcare, for example, the need for scientific evidence on how it impacts quality of care, including clinical, interpersonal, and managerial dimensions, and the need for shared norms or practices, such as whether the healthcare professionals see a clear need for the technology. By so doing, this paper adds a novel perspective to the extant literature and provides new directions for future research.

5.4 Article 4: Multichannel consultation service design in hospitals: Implications for service efficiency and effectiveness

5.4.1 Objective

Our previous study identified that there is a lack of common understanding of how different channels should be used for different types of consultations. Ad hoc decisions and lack of formalized service structure can create turbulence for both provider and consumer of the service and hamper quality of care (Bitner et al., 2008; Ostrom et al., 2015). Therefore, this paper aimed to identify how a consultation service can be designed to incorporate both PCs and RCs, i.e., TCs and VCs. In this paper, the consultation service was framed as a MC service providing three channels, i.e., in-person, video, and telephone, to provide consultations. The task technology fit (TTF) theory, which was used as an underlying concept, posits that for a technology to have a positive impact on performance, it has to be used by the individuals and must be a good fit with the task it supports (Goodhue & Thompson, 1995). We drew on this theory to develop a theoretical model to study how consultations (PCs, VCs, and TCs) are organized in a hospital to identify a recurring pattern of the service structure, based on which we suggested a set of design propositions. In addition to TTF, the MC service literature was applied, and parallels and distinctions were drawn between MC consultation services and MC retail services.

5.4.2 Methodology

We used a multiple case design where the unit of analysis was the MC consultation pathway, i.e., the set of consultation sessions conducted using different channels for an individual patient. In total, 20 consultation pathways were studied in a university hospital in Norway. Interviews with managers, patients, and clinicians were used as primary sources of data to map the MC care pathways. In total, 20 MC care pathways were included on this study. To enhance contextual understanding, archival data and observation notes from an annual seminar were taken into account. The data collection process continued for two years from August 2019 to August 2021. The dimensions from the theoretical framework were consultation characteristics (i.e., chronicity, severity, complexity, need for physical examination), channel characteristic (i.e., interface richness, effort to travel, effort to connect digitally), and preferences for stakeholders (i.e., managers, clinicians, and patients). We used the logic of cross-case pattern search: we compared different consultation pathways to identify recurrent patterns of use of channels across different consultation situations and identified the reasonings or justifications behind these patterns to propose design propositions.

5.4.3 Findings

The main findings can be divided into three parts. First, using TTF theory, the study provided a novel framework to evaluate the suitability of different channels for different types of consultations. The framework proposed a set of characteristics of consultation services and channels that are key to inform MC service design decisions. The identified consultation characteristics are severity, complexity, chronicity, and need for physical examination; and the identified channel characteristics are interface richness, travel accessibility, and digital accessibility. The study also identified differences in the preferences of key stakeholders' (management, clinicians, and patients) for using the channels for consultation. Second, the study explained how MC consultation service designs can support different strategic priorities. The study identified four main strategic priorities—cost reduction, waiting time reduction, patients' convenience enhancement, and quality of care enhancement—that drive MC consultation service designs. Third, based on the prior two contributions, the study put forward propositions to guide the design of MC consultation services. Our design propositions indicate that strategic application of multiple channels for consultation services can reduce the trade-off between effectiveness and efficiency of the service. Thus, strategic and purposeful design of MC services can lead to resource efficiency while facilitating customization resulting in patient-centered care. The propositions are as follows:

Proposition 1: The use of remote channels for consultations about conditions with lower complexity, lower severity, lower clinical need for physical examination, and higher chronicity mitigates trade-offs between the service's effectiveness and efficiency when other conditions remain unchanged.

Proposition 2: Under a service cost reduction strategy, the use of remote channels for consultations with lower complexity, lower severity, lower clinical need for physical examination, and higher chronicity favors service efficiency while mitigating adverse impacts on service effectiveness when other conditions remain unchanged.

Proposition 3: Under a service experience augmentation strategy, using remote channels for consultations with higher severity and complexity, irrespective of chronicity levels and physical examination requirements, favors service effectiveness while mitigating adverse impacts on service efficiency when other conditions remain unchanged.

Proposition 4: Under a convenience enhancement strategy, the use of RCs combined with PCs favors service effectiveness (in the form of customization), while mitigating adverse impacts on service efficiency when other conditions remain unchanged.

Proposition 5: Under a responsive care provision strategy, using remote channels as additional capacity while using existing capacity for PCs favors service effectiveness (waiting time reduction) while mitigating adverse impacts on service efficiency when other conditions remain unchanged.

5.4.4 Contribution

This article contributes to enhancing our understanding of the service design of MC consultations in hospitals, how the extant MC service literature can be applied in MC consultation service design, and why this service may require a different design formulation. In so doing, the article also sheds light on the challenges that are intrinsic to service design in healthcare. In particular, our analysis indicates that the relationships between clinicians and patients, as well as those between clinicians and hospital management, play an important role in the design and implementation of IT-based services. Clinicians play a dual role of being the most knowledgeable people in the delivery of care due to their professional training and skills and being users of the technology in question. Being both professional experts and users, they are much better placed to choose a channel compared with patients. This analysis challenges the underlying assumption of MC service literature that it is ultimately the customer who chooses the channel, which is valid for commonly studied MC services such as banking and retail. However, for MC consultation, patients are less likely choose a channel on their own. Thus, the division of voice of customer and voice of provider cannot be clearly distinguished in IT services. Consequently, the study identifies challenges of designing IT-based care services: (1) the patient's channel preference is easily ignored, which can have negative consequences on quality of care and patient satisfaction (Gittell, 2002; Zeithaml & Bitner, 2000) and (2) the channel choices made in MC services may remain ad hoc (i.e., channel choices do not follow a common logic, but are based on individual clinician's understanding) because management has less control over the design and implementation of the service. Clinicians, as professionals, tend to have high autonomy and discretion in the way they work (Mills et al., 1983; Zardkoohi et al., 2011). These theoretical contributions also provide insights

for practitioners on what should be considered while deploying remote channels in consultation services. Specifically, the design propositions focus on the strategic application of remote channels to enhance the effectiveness and efficiency of consultation service.

6. Findings: Changes, mechanisms, and implications for outcome

This chapter answers the two RQs: (1) How does telemedicine deployment introduce changes in the service operations of care delivery processes in healthcare organizations? (2) What are the implications of these changes for healthcare performance? The findings are synthesized following the research framework (figure 1), i.e., in the order of changes in service operations, underlying mechanisms, and the implications on healthcare performance. Sections 6.1 and 6.2 present the findings from RC and DM services, respectively. At the end, table 3 summarizes the findings.

6.1 RC service

In the RC service, video and telephone calls are used to provide consultations, thus the interaction among patients and clinicians changes from direct communication to an IT-mediated distant interaction. The application of an IT-based channel makes it possible to receive a service from a distance, providing flexibility to clinicians and patients, and reduces patients' need to travel to the hospital. Next, we identify that a decision-making task has been added to clinicians' routine of consultation. Clinicians are required to decide for each consultation whether it can be conducted via a remote channel and, if so, which remote channel. Individual clinicians use different criteria to make this decision and differing opinions exist regarding the suitability of channels for different consultations. Thus, the changes in the service operations of RCs can be categorized into two parts: new kinds of communication between patient and clinicians, and new decision-making by clinicians to sort patients' needs across traditional and IT-enabled channels.

In the RC service, three different mechanisms for performance improvement are identified (table 3): *generating less-expensive capacity*, *generating additional capacity*, and *providing service alternatives*. The PC service is more expensive than remote channels because it includes the cost incurred by patients' travel to hospital. Thus, remote channels incur lower service costs than PCs. On the other hand, remote channels can be used as additional channels so that the number of consultations conducted by the hospital is increased. For this to happen, the remote channels should be used not as replacements but rather in addition to ongoing PCs. Because RCs are less expensive than PCs (Greenhalgh et al., 2018; Müller et al., 2016), the enhancement of capacity incurs reduced costs compared to the costs incurred by the same number of PCs. Through the mechanism of capacity enhancement, the waiting time can be reduced, which can positively impact service effectiveness. However, whether this mechanism is cost efficient or not depends on the overall resource alignment or existing bottlenecks in a hospital. The next mechanism for improving performance in RCs is increased customization. The availability of alternatives for consultations adds flexibility to the service, leading to more personalization. The service can be better customized by choosing appropriate channels based on the patient's convenience and health condition. Thus, the quality of care can be enhanced and the effectiveness of consultation service can be improved.

6.2 DM service

In the DM service, two communication interfaces are identified that are not present in traditional care delivery process: (1) face-to-face interactions between nurses and GPs to include patients in the DM service and (2) app-mediated interactions between patients and nurses. Additionally, individual patient treatment plans provided by GPs to the nurses work as a coordination mechanism that standardizes how nurses address individual patients' needs. First, there is a patient selection process to decide which patients are suitable for the DM service. The GPs are responsible for identifying those patients who would benefit from this service, offer this alternative service to them, and include them in the service if they agree. Selecting patients for an IT-enabled service is a novel task for GPs and, so far, they have used their own knowledge and understanding of their patients to perform it. Although there is a preliminary level of understanding on a disease level, i.e., which diseases are better suited for DM services (Hussey et al., 2021), the GPs are required to make decisions on the patient level, i.e., choose individual patients for the service, for which evidence-based guidelines do not exist.

Another change in the DM service is the sharing of clinicians' responsibilities with nurses and patients. In the DM service, nurses are given the responsibility to monitor and provide care to patients so that the patients require less attention from GPs and emergency and specialized care. Nurses play the roles of technical coordinators, data workers, and empathetic listeners to provide the service to the patients. Sampson (2018) identified three basic modes of how IT systems can change professionals' work, one of which shows that IT can help less-skilled professionals or paraprofessionals take on some activities previously performed by more highly skilled professionals (Sampson, 2018). Because the empathic part of care is the most difficult to replace with IT (Huang & Rust, 2018), in this mode, the nurses are given the responsibility of the empathic part of care, whereas the IT system is concerned with the specialized knowledge part of care. Additionally, nurses become overall coordinators of the service, from solving patients' technical issues to coordinating with GPs about which patients to include in the service and developing the care plans. In the DM service, the specialized knowledge is not replaced by the app entirely, but rather by the combination of the app and the individual treatment plans provided by the GPs.

Similarly, patients are given the responsibility to measure and provide their health data and send them to the nurses using an app. The deployment of the DM app makes it feasible for the patients to perform this task. The patients have increased responsibilities in the DM service and patients' participation in the care delivery process becomes more crucial, i.e., the nurses can provide necessary care only if the patients provide the data on a regular basis.

In the DM service, four different mechanisms for performance improvement are identified: *generating less-expensive capacity*, *providing preventive service*, *generating additional capacity*, *providing service alternatives*. Generation of less-expensive capacity takes place in two ways. First, this service makes it feasible to transfer some tasks to a lower-paid group of

professionals (nurses) from higher-paid professionals (GPs), thus lowering the service cost. Second, because the service is primarily about monitoring health data on a screen rather than meeting with a patient each time, a few nurses can provide the service to a larger number of patients compared with GPs or specialized care thus reducing service cost per patient. Thus, the DM service can contribute to service efficiency by replacing expensive capacity with less-expensive capacity. By monitoring patients' data on a regular basis, it is feasible to detect the deterioration in patients' health at a much earlier stage than with traditional care. This early detection makes it possible for nurses to take preventive measures to stop or at least reduce the deterioration of health. This mechanism of preventive care can provide a better quality of care by preventing patients going through difficult health situations, emergency admissions, and GP consultations. Thus, the preventive care mechanism can improve service effectiveness by providing more responsive treatment to patients. It also frees up capacity in different healthcare organizations, such as emergency services and GPs, which can be used for patients with more serious health conditions. Thus, adding capacity is another mechanism through which the DM service can improve resource utilization in healthcare, improving service efficiency. Lastly, the DM service can provide a customized service to patients; the different needs of individual patients can be met more precisely by allocating them to traditional care or DM care. If a patient's health status is more stable and regular monitoring can keep the patient safe and well, then the DM service can provide preventive care, while the patient with more unstable, irregular conditions can be provided with GP consultations and specialized care as required. Thus, the DM service can provide patient-centered healthcare where care delivery is more flexible in addressing an individual patient's needs.

In total, four mechanisms for improving performance through IT deployment are identified, three of which are shared by both RC and DM services: *generating less-expensive capacity*, *generating additional capacity*, *providing service alternatives*. The fourth mechanism, *providing preventive care*, is a mechanism identified only for the DM service. These findings indicate that, in general, IT-enabled services can create additional capacity at a lower cost and add alternatives to the service offerings making the service customizable without incurring as much cost as in-person services. However, as the fourth mechanism of the DM service indicates, depending on the functionality of the IT, mechanisms can vary from IT to IT and not all the mechanisms are shared by all types of IT.

Table 3: CIMO configuration of RC and DM services

Context	Intervention	Operational changes in care delivery process	Mechanism	Outcome
Specialized public hospital	RC service	New ways of interacting in audio and video consultations.	Generating less-expensive capacity	Efficiency: reducing capacity cost

		Categorizing patients' needs and offering them the suitable channels.	Generating additional capacity	Effectiveness: providing responsive service, reducing waiting time Efficiency: lowering cost of additional capacity (efficiency depends on bottlenecks in the hospital)
			Providing service alternatives	Effectiveness: customizing the service to individuals' requirements
Municipality and GP care	DM service	New coordination mechanism: App, standard procedure (treatment plan), teamwork (GP, nurse, patient). Sharing the responsibilities of GPs with nurses and patients. Categorizing patients' needs and offering them the suitable channel.	Generating less-expensive capacity	Efficiency: reducing capacity cost
			Generating additional capacity	Effectiveness: providing responsive service, reducing waiting time Efficiency: lowering cost of additional capacity
			Providing preventive care	Effectiveness: providing responsive service, customizing the service to individuals' requirements
			Providing service alternatives	Effectiveness: customizing the service to individuals' requirements

By answering the RQs, this chapter addresses the first part of the problem statement by identifying how IT deployment can lead to performance improvement. The analysis of the empirical materials demonstrates several mechanisms through which IT deployment can improve several aspects of healthcare performance along both effectiveness and efficiency dimensions.

7. Discussion and theoretical contribution

This chapter addresses the second part of the problem statement by identifying why IT deployment most often fails to improve healthcare performance in reality. This is done in two sections. First, I discuss a set of operational paradoxes of IT deployment and then I put forward an explanation of how these paradoxes lead to unsuccessful implementation of IT deployment, which in turn limits performance improvement. The theoretical contributions made by this thesis are pointed out along the way.

7.1 Operational paradoxes of IT deployment

A set of paradoxical observations can be made from the changes in service operations found in the DM and RC cases. Paradox implies the persistence of contradictory aspects that create a seemingly absurd situation (Putnam et al., 2016). A distinct nature of paradoxes is that there is no way to eradicate or mitigate these contradictions, and instead they have to be managed (Smith & Lewis, 2011; Wit, 2017). Paradoxes found in management and organizations are not necessarily logically paradoxical, but the reconciliation of contradictory aspects within an organization is challenging and they can lead to complex organizational situations (Poole & Van de Ven, 1989). Three operational paradoxes have been identified here that complicate the relationship between IT deployment and performance improvement: *paradox of coordination*, *paradox of changing roles*, and *paradox of decision-making*. Additionally, it is paradoxical how the extant literature has been skewed towards the rather optimistic facets of these paradoxes and overlooked the rather complex aspects of healthcare IT deployment.

7.1.1 Paradox of coordination

The care delivery process in the DM service requires new types of coordination: (1) the treatment plan for individual patients that works as a standard operating procedure for the nurses to treat the patients; (2) coordination between the GP and the municipality nurses; and (3) coordination between nurses and patients that includes home visits. While examples of how IT deployment can improve communication and coordination is rife in the literature (e.g., (Chen et al., 2013; Drupsteen et al., 2016; Plantier et al., 2017), our analysis shows that IT-enabled services also require *complementary* coordination mechanisms. The application of the DM app provides the opportunity to record, store, and transfer health data from a patient to the monitoring nurses. However, these new functions cannot operate in isolation but rather require additional coordination to support them. The combination of additional coordination mechanisms and functionalities of the DM app is essential to actualize the benefits of the DM app.

I identify this as paradox of coordination where the deployment of IT adds new coordination channels that seemingly ease the coordination, but essentially require additional coordination processes and effort to support them. Thus, IT deployment necessitates changes in inter- or intra-organizational coordination to actualize the IT-enabled communication in the care delivery process. While the storing and transfer of patients' data can be ensured by applying an app, other intra- and inter-organizational coordination processes are required to manage

the flow of the data and use the data in the care delivery process. The coordination between GP and municipality nurse is a form of inter-organizational coordination, because the municipality nurses and GPs belong to two different healthcare organizations with different resources and goals; only 10% of GPs are employed by the municipalities on a fixed salary, whereas the rest are self-employed and receive remuneration from the government under different schemes (Eide et al., 2017; Fastlegestatistikk, 2017). Inter-organizational coordination requires greater effort and explicit attention than intra-organizational coordination, and this is even more the case in healthcare settings because the functional groups are clearly separated by strong professional identities with differentiated skills and statuses (Gittell & Weiss, 2004; Wicks, 1998). In the DM service case, such effort or explicit attention was not visible, and the municipality care management was looking for ways to contact and connect with GPs so that they could continue including patients in the service. At present, the number of patients receiving the DM service entirely depends on how nurses and GPs coordinate among themselves to find new patients. Thus, without proper coordination mechanisms, the demand for the service becomes uncertain, which makes the planning and allocation of resources difficult.

7.1.2 Paradox of decision-making

While the literature incessantly emphasizes the possibility of data-driven decision-making as a merit of applying IT tools in healthcare services (Janakiraman et al., 2023; Laker et al., 2018), our study indicates that IT application simultaneously adds a need for a new type of decision-making, i.e., selecting suitable patients, which goes beyond the clinical schema of providing treatment. Currently, healthcare professionals are not used to making such decisions in their work routine. I identify this as the paradox of decision-making, where the deployment of IT, while creating opportunities for data-driven decision-making, simultaneously requires healthcare personnel to make new decisions to use the IT for delivering care.

In both DM and RC services, there is a need for categorizing patients' needs more precisely in order to deliver the care through the right channel. Because not all care services are equally suitable for delivery through IT-mediated processes, it is essential to decide what can be offered through IT-mediated channels and what requires an in-person care delivery process (Sousa et al., 2016). Depending on interface richness and accessibility, these types of IT are suitable for different types of care delivery (Sousa & Voss, 2006). For example, in-person interactions have high interface richness, i.e., high intimacy, real-time communication, and information richness, compared with remote interactions (Brunelle, 2009; Kellogg & Chase, 1995). Therefore, it can be said that in-person interactions are more suitable than remote interactions when the treatment situation is complex, i.e., high information load, uncertainty, dubious connection between means (i.e. treatment) and ends (i.e. recovery) (Campbell, 1988a; March & Simon, 1958). The higher the complexity, the higher the cognitive demand and the higher the need for physical proximity (Sawhney et al., 2005; Zigurs & Buckland, 1998). Thus, planning is required to decide which service can be provided using the DM app or video and telephone calls.

In both DM and RC cases, the healthcare professionals, i.e., GP and clinicians, respectively, are given the role of selecting suitable patients for these services. Although clinical decision-making is an integral part of their work routine, our research shows that identifying patients' suitability for an IT-enabled service is not entirely clinical, but includes interpersonal and managerial aspects and depends on the technical ability of patients (Enam, Dreyer, & De Boer, 2022). Moreover, the clinical aspect is not diagnosis-specific, but patient-specific, and can vary over time for the same patient. Therefore, the role of patient selection adds new requirements to clinicians' work routines. Besides, unlike evidence-based treatments they offer, the underlying bases for patient selection for IT-enabled services are yet to be proven and shared as norms. Lastly, because patient safety and wellbeing are the highest goals of all, professionals are often hesitant to make this decision to minimize the risk associated with choosing the wrong patient for these services. This task of patient selection directly impacts the demand for IT-enabled services and the service design, just as GP referrals directly impact the demand for specialized healthcare (Svedahl et al., 2019). Moreover, the decisions related to patient categorization have greater impact on the design and management of IT-enabled services because the use of different channels for different services is directly dependent on this decision. Thus, without a having a stable patient selection process, the demand for these services remains sporadic, and their design and implementation become problematic. Additionally, ad hoc patient selection creates variability in the service offering, risking both the effectiveness and efficiency of the services (Bitner et al., 2008).

7.1.3 Paradox of changing roles

The paradox of changing roles refers to the additional responsibilities given to patients and nurses in IT-enabled care delivery processes. The literature and public reports contain stories about how telemedicine can empower patients in managing their own health by making correct and timely information available to them (e.g., (Nielsen & Johannessen, 2019; Risling et al., 2017; Veinot, 2010). Our study indicates the opposite side of the coin where significant responsibilities are handed over to the patients in the telemedicine service. The DM service requires the patients to upload their health data on the app regularly to receive a responsive and preventive service. Thus, patients' active participation becomes a necessary condition determining whether and to what extent the DM service can be successful in providing the care that patients need. This is an important aspect to consider while deploying such IT into care delivery services because not all patients are equally eager and able to actively participate in their care creation process (Andreassen & Trondsen, 2010; McColl-Kennedy et al., 2017). Having customers/consumers as part of the care creation process adds major challenges in services in general, because customers are diverse and so is their participation (Frei, 2006). Thus, the increasing dependence on patients' participation adds even more uncertainty and thereby complexity to the service. It is difficult to estimate the extent to which these patients will engage in managing their health in a proactive manner, i.e., measuring and sharing the data and answering questions regularly, even on days when they do not feel unwell. Unlike healthcare personnel, patients do not have any formal contract to carry on these tasks; rather,

they are relied upon to take this responsibility. It is noteworthy that patients' participation in DM is different from the intrinsic aspect of service where the customers' participation in the service is inherent as the creation and consumption of a service cannot be separated. In DM, patients have the more significant and even proactive role of providing health information.

Sharing tasks with customers to create services with an aim to reduce the internal capacity requirement is not a novel idea and has been implemented in different industries, such as restaurants, banking, and grocery stores. However, the consequences of mistakes or the inability to serve a patient as necessary is much graver compared with other services. Moreover, research shows that the consumer of a service participates actively to create a service only when there is a clear incentive, i.e., they can clearly see the benefit of doing it on their own (Christensen et al., 2010). The benefits of using the app, i.e., receiving preventive care or, requiring fewer visits to the GP or hospital, are not immediately recognizable, which may make patients less willing to participate. Nonetheless the operational implications of giving responsibilities to patients in the care delivery process have been inadequately addressed to date. In the current service design, we do not see any effort to identify or even consider why a patient would (or would not) actively participate in this service, or how diverse levels of participation could be managed at the operational level.

Besides patients, nurses take up various new responsibilities. Apart from the role of coordination discussed earlier, nurses are required to work with data and make sense of them to provide care from a distance. In the current service, nurses receive minimal training, i.e., learning by doing, to accomplish such data-related work. However, nurses have revealed that to work in the DM service, "one needs to like technology." Research has shown that healthcare personnel's skill and ability to work with technology positively influence the degree of their involvement in technology-enabled work, and lack of technical competence is one of the most common reasons for not applying technology at work (Kuek & Hakkennes, 2020). In general, there is a gap between existing and necessary digital competence at professional workplaces and the gap is even wider in the healthcare sector (Terry et al., 2019). The lack of training for digital competence can impede sustainable and large-scale applications of IT-enabled services. In the current service design, nurses' competence in using patients' data to deliver services is taken for granted, although nurses feel that working in the monitoring center requires a different mindset than providing in-person care. It is noteworthy that digital competence is not only about technical know-how, but includes attitude to and confidence in using technology at work (Oberländer et al., 2020). Therefore, it might be that the nurses require training that goes beyond how to use the app and prepares them to deliver data-driven and distant care. Although the literature on nursing education has been quite vocal about the requirement for new skills to work in rapidly changing healthcare settings, the management field discussions are skewed toward the issue of de-skilling of clinicians (see (Sampson, 2018), rather than how IT affects the other working groups such as nurses. Availability of patient data is supportive to nurses in providing preventive care to patients, but it might not be enough for this role.

In practice as well as in the extant literature, there seems to be an insufficient awareness about how the roles and responsibilities of patients and nurses change in IT-enabled services. Thus, implications of these changes on the operational level of service delivery are neither clear nor managed. I identify this as the paradox of changing roles, where IT deployment simultaneously causes additional responsibilities and consequential complexities along with possibilities of patient empowerment and task delegation from physicians to nurses. Both the literature and the services studied in this project largely overlook these responsibilities and their implications on care delivery processes. This adds an additional layer of uncertainty and complexity to the service, which makes the large-scale implementation and benefit realization of these services far less feasible than they need to be.

Among the three paradoxes, the paradox of decision-making was observed in both DM and RC services, whereas the paradox of coordination and paradox of changing roles were observed in the DM service only. This indicates that these paradoxes are contingent upon the functionalities of the IT being deployed as well as the structure of the organizations, e.g., GP, municipality care, specialized care, using the IT. Nevertheless, these paradoxes add new insights by indicating that the effect of IT deployment is more complex than it has been portrayed in the extant literature. While the literature has been successful in identifying that the application of IT can strengthen coordination among different entities, empower actors with information, and facilitate decision-making based on objective information, the literature has been inadequate in identifying that the application of IT demands larger changes in the care delivery process, including new forms of inter- and intra-organizational coordination, redistribution of work among different levels of healthcare personnel and patients, and additional decision-making tasks. I argue that the limited awareness and understanding of these aspects hinder the large-scale implementation of IT in healthcare, which consequentially inhibits the potential performance improvement that can be actualized. A theoretical explanation of this argument is developed in the next section.

7.2 Towards a theory of improving performance through IT deployment

The operational paradoxes indicate that the changes that the service operations of care delivery processes go through due to IT deployment can be of two kinds, namely (1) *direct changes* and (2) *complementary changes*. The direct changes correspond to the easier and positive facets of the paradoxes and are triggered directly by the functionalities of the IT being used, such as remote interactions between patients and health personnel via VCs and TCs, and sharing and monitoring of health data via the DM app. On the other hand, complementary changes correspond to the more complex facets of the paradoxes and are not directly caused by the IT functionalities but occur to accommodate the direct changes. Examples of complementary changes are treatment plans (so nurses can make decisions using the data) and patient selection (so the IT-enabled channels are applied appropriately). Although the direct changes are the consequences of the application of IT, they can only be scaled up and sustained in the care delivery process with the support of the complementary changes. Both changes are necessary to actualize the healthcare performance improvement mechanisms,

namely, generating less-expensive capacity, generating additional capacity, providing service alternatives, and providing preventive care. While the direct changes provide the technical basis on which these mechanisms can function, the complementary changes are required to make the situation conducive for the activation of these mechanisms. Only the combination of direct and complementary changes can anchor IT deployment in an organization and initiate performance improvement.

The differentiation between the direct and complementary changes demonstrates that focusing on an individual's use of IT can provide only a limited understanding of successful IT implementation, described as the incorporation or routine use of a technology on an ongoing basis in an organization (Szulanski, 2000). The literature on different user acceptance of technology models (Alsyouf & Ishak, 2018; Davis, 1989; Venkatesh et al., 2007) has analyzed how individuals in an organization use technology in their work. This thesis shows that such analysis can predict the direct changes but not the complementary changes. Complementary changes require greater organizational effort, which is not simply the summation of the application of IT by all individuals in the organization. Specifically, the complementary changes point out a void in healthcare IT deployment: an absence of managerial preparedness that would facilitate the organization-wide application of IT. Based on the concept of management model (Bodrožić & Adler, 2018), I use the term "managerial preparedness" to imply a distinct body of ideas that inform managers how to fulfill organizational tasks under certain situations. Concerning IT deployment, the focus (of literature and healthcare organizations) to date has been quite short-sighted and aimed towards exploiting the effects of the direct changes only. Consequently, the managerial preparedness for complementary changes has been inadequate. A brief elaboration of plausible reasoning behind this inadequacy is developed below.

Different technology revolutions pose different managerial requirements to the organization and the distinguishing feature of the IT revolution is that it has a process orientation where the interfaces of various processes within and between organizations are linked and managed through IT systems (Bodrožić & Adler, 2018; Cooper et al., 1997; Garcıa-Dastugue & Lambert, 2003). The cases studied in this thesis also show that the IT connects the actors in care delivery processes in new ways and calls for new forms of collaborations among hospitals, GPs, and patients. However, the characteristics of healthcare service operations discussed in chapter 3 are seemingly not in favor of process orientation. In order to address the high variation in demand, e.g., large variety in diagnoses and different interpersonal needs of individual patients, healthcare organizations originally had a functional orientation for task and resource allocation and coordination (Cyert & March, 1963b; Lillrank, 2012). The complexity of care services necessitates that service delivery processes are standardized and routinized (Campbell, 1988b; Cohen et al., 1996). Additionally, the professional nature of service provides the clinicians and GPs in specialized and primary care a certain autonomy and authority and creates a rigid division of labor among different healthcare personnel types. On the other hand, the identified mechanisms—providing service alternatives, providing preventive care—

indicate that IT deployment incorporates additional variables and contingencies in care delivery processes, and requires more flexible and seamless service delivery processes within and across organizations. The new interdependencies among different healthcare units (within or between organizations) are a burden for specialized and standardized service design (March & Simon, 1958).

All these aspects make it difficult to bring the complementary changes into care delivery processes. Therefore, healthcare organizations tend to focus on the low-hanging fruits of IT deployment, i.e., the direct changes, and ignore the necessity of complementary changes that require a process orientation and the redesign of care delivery processes, which is difficult to achieve and manage. Moreover, unlike interventions such as lean management, continuous improvement, and total quality management, IT interventions do not come with managerial content and principles (Benders & Van Bijsterveld, 2000) on how to organize tasks and define new roles and responsibilities, which might make the redesign even more difficult.

Previous research on the application of technology in organizations has developed theories on how technology deployment triggers alterations in organizational structures (Barley, 1986), interacts with organization design and agency (Mutch, 2010; Orlikowski, 1992), and can be facilitated by different organizational learning processes (Edmondson et al., 2001). This thesis focuses more specifically on the service operations in the care delivery processes where the technology is being used and, based on the identified changes in the operations, it explains why IT implementation seldom improves healthcare performance. The implications of IT deployment from an OM perspective have been inadequately researched to date and this thesis attempts to look in that direction.

Organizational paradoxes are considered as a resource for theory building where inconsistency or contradictions in empirical observations lead to new speculations that can contribute to theory (Alvesson & Kärreman, 2007; Poole & Van de Ven, 1989). Here, the identified operational paradoxes are used to analyze the implications of IT deployment, and so provide an explanation of unsuccessful implementations of IT in healthcare. Poole and Van de Ven (1989) proposed four ways of managing organizational paradoxes: accept and use the paradox constructively; separate the paradox spatially; separate the paradox temporally; and introduce new terms to resolve the paradox. In the theoretical explanation developed above, I separate the paradoxical situations in terms of direct and complementary changes. This can be compared with spatial separation because the direct changes happen as a consequence of IT deployment whereas the complementary changes should be carried out by management to support the direct changes.

A theory usually has four components: definitions of terms or variables, a domain where the theory is applicable, a set of relationships among the variables, and specific predictions (see (Walker et al., 2015b), for a detailed description). In this thesis, first I identify four mechanisms that demonstrate specific ways of improving performance by deploying IT. Next, I identify and

define the operational paradoxes and direct and complementary changes, which are the terms or concepts used to explain the reasons for unsuccessful IT deployment. Consequently, I clarify the relationship between direct and complementary changes, i.e., sustaining the former depends on establishing the latter, and explain how this relationship affects the implementation of IT. The explanation developed here is applicable within the domain of healthcare organizations and might be relevant for IT deployment in other professional service organizations as well. Therefore, I consider the explanation developed in the thesis to be an important step towards developing a consistent and concise theory on improving healthcare performance through IT deployment.

8. Implications for practice

For IT deployment to lead to performance improvement, healthcare organizations need to provide the right conditions such that the mechanisms can be activated to enhance performance. To provide the right conditions, this thesis suggests that managers delve into the issues of misalignment between the changes in operations and service design, and between strategic orientation and organization design, and identify how these can be resolved. Additionally, this thesis suggests that practitioners need to have more realistic expectations of IT and focus on intra- and inter-organizational processes beyond investing in and introducing IT in their own respective organizations. Because the complementary changes require the involvement of stakeholders from different levels, including the policymakers, local authorities, and government, and they concern fundamental changes in the healthcare service structure, the management of healthcare organizations can play a crucial role in achieving those changes. Specifically, managers can focus on the following aspects while deploying IT in their organizations: (1) alignment of service configuration; (2) formalization of roles; and (3) alignment of resources and goals.

Alignment of service configuration implies the compatibility between the design of an IT-enabled service and the existing service. I posit that the lesser the degree of compatibility, the lesser the probability that the complementary changes can be sustained without organized effort. For example, in the DM service, there is a need for inter-organizational coordination (between GPs and municipality nurses). In the traditional service structure, such coordination is not required, so establishing this coordination in the DM service requires significant effort and resources (Gittell & Weiss, 2004). However, if the DM service is to be implemented in a specialized care setting, a hospital for example, the doctors and nurses will be within the same organization, so they will already have a routine for coordination between them and thus the change will be easier to achieve. Therefore, there is a higher possibility that the mechanisms will be activated and impact performance.

Formalization of roles implies that the changes in roles are considered, the new responsibilities and tasks are defined, and personnel are provided with necessary organizational support such as training, knowledge, and guidelines. Although, for a new service with fewer patients, these roles and their activities can be taken for granted, in a scaled-up service, the changes cannot be managed without formalization of the roles.

Lastly, alignment of resources and goals implies that the deployment of an IT-enabled service needs to have strategic anchoring and the IT-enabled service must be designed according to the strategic goals. The article about the RC service design (summarized as the fourth article in chapter 5) explains that the same RC service can be used for increasing efficiency and effectiveness depending on how the service is designed. For example, remote channels can be deployed to increase the number of follow-up consultations for critical patients to increase the service effectiveness, or to replace the PCs for patients with less complex and less severe conditions to increase service efficiency. The strategic use of an IT-enabled service also

involves resource alignment, i.e., the design of the IT-enabled service depends on the type of resource constraint. For example, when the bottleneck is the number of clinicians, then increasing the number of consultations using remote channels is costlier than when the bottleneck is the number of consultation rooms, because the clinicians are paid overtime in the first scenario, which costs more than the additional space required in the second scenario.

The above mentioned aspects broadly outline how managers can prepare themselves in a better way to deploy IT in their respective organizations. However, the managerial actions can vary to a great extent depending on the functionalities of IT and where it is deployed. Based on the analysis of this thesis, it can be said that as long as managers are aware of the importance of the complementary changes and take them in to account while deploying the IT, it is more likely that they will achieve better outcomes.

9. Conclusion

This chapter first summarizes the findings of the thesis, then it explains how this thesis contributes to the understanding of IT deployment in healthcare, as well as to the service OM literature, and creates opportunities for future research.

The aim of the thesis was to create pragmatic knowledge on IT deployment in healthcare from an OM perspective. The problem statement was: how can IT deployment lead to performance improvement and why does it fail to do so in many cases? In order to address the problem statement, a research framework was created, which led to two RQs: (1) How does telemedicine deployment introduce changes in the service operations of care delivery processes in healthcare organizations? (2) What are the implications of these changes for healthcare performance? The thesis includes four scientific articles that answer the RQs and, based on the findings from these articles, it provides an answer to the problem statement.

The identified changes in the service operations in the care delivery processes of IT-enabled services can be briefly listed as new ways of interacting between patient and healthcare personnel using IT-enabled channels, categorizing patients' needs to allocate them to suitable channels, new coordination mechanisms to support communications through new channels, and sharing the responsibilities of clinicians and GPs with patients and nurses. From these changes, four mechanisms of improving healthcare performance through IT deployment have been inferred: generating less-expensive capacity, providing preventive service, generating additional capacity, and providing service alternatives. Three of these mechanisms were identified in both DM and RC services, while providing preventive care was identified only in the DM service. These mechanisms answer the first part of the problem statement: how can IT deployment lead to performance improvement? The mechanisms clearly demonstrate that IT has the potential to improve healthcare performance and indicate that different IT-enabled services may have different mechanisms to improve performance.

Next, I developed a theoretical explanation that answers the second part of the problem statement: why IT deployment fails to improve healthcare performances in many cases. An explanation has been developed based on the set of paradoxes identified from the changes in the care delivery process: paradox of coordination, paradox of decision-making, and paradox of changing roles. Each of these paradoxes has two contradictory facets, one of the facets being more difficult to manage than the other. The extant literature has been noticeably skewed in depicting the rather easier and positive facets of IT deployment, giving a limited understanding. The paradoxes help us to provide a more comprehensive picture of IT deployment by specifying the kinds and extent of preparedness required to deploy IT and consequently improve our understanding of why deploying IT is difficult to manage in healthcare organizations, as explained below.

The simple and complex facets of each paradox correspond to different kinds of change in the care delivery process. In other words, when IT is deployed in a healthcare organization, the

care delivery process requires two types of adjustments: direct changes and complementary changes. While the direct changes occur as consequences of using the IT and depend on IT functionalities, the complementary changes need to be planned and executed on an organizational level and depend on managerial effort. So far, the complementary changes have not been given the importance or attention they deserve, thus organizations remain ill-prepared for applying IT in their ongoing care delivery processes. The direct changes in a care delivery process give us a vague idea that the IT is successfully implemented and may even show certain performance improvements at the initial phase of IT deployment, in pilot projects, etc. However, large-scale implementation of the same IT becomes problematic as the care delivery process is not supported by suitable organizational adjustments to provide coordination structures, guidelines and norms to support decision-making, and resources and training to perform new roles. Thus, the organization-wide deployment of IT remains unsuccessful with implications of limited performance improvement.

On a broader level, this thesis puts forward three aspects of healthcare IT deployment. First, a successful deployment of IT, i.e., the incorporation or routine use of IT on a continuous basis in an organization, requires deeper organizational changes than the changes that come along with the initial use of IT by designated personnel. Although IT has the potential to improve both effectiveness and efficiency of healthcare services, for this potential to be realized in the real world, changes must be made in care delivery processes on the level of operations or tasks of individuals and on the level of organizational structure, e.g., policy, resource allocation, division of labor. Moreover, IT deployment can only trigger the need for these changes, but it cannot establish and manage those changes. It is the healthcare personnel and the healthcare organizations that can deliberately plan to achieve those changes and make them sustainable. We tend to expect that increasing investment and sporadic use of IT will alleviate the current healthcare issues. However, for IT to play its part appropriately, healthcare organizations and personnel must play a bigger role than that practiced and portrayed in the literature. Second, this thesis indicates that there is a tension or contradiction between the existing organization and management of care delivery processes and the care delivery processes triggered by IT deployment. The changes in the service operations of the DM and RC services show that deployment of these IT solutions delivers more flexibility, alternatives, and responsiveness (table 3) in the care delivery processes by adding new communication channels that connect the care providers from different organizations and patients in novel ways. However, the existing structures of healthcare organizations do not have provisions for such connectivity and rather have siloed structures and rigid divisions of labor. Thus, there is a chasm between how the care delivery process should be designed (as discussed in the previous point) for IT deployment to be beneficial and how the current care delivery process is. This also explains why the establishment of complementary changes is difficult and mostly ignored in organizations. On the one hand, the specialization and functional divisions are essential to provide a healthcare service efficiently (Lillrank, 2012). On the other hand, it seems that the different care delivery processes offered by different

healthcare organizations need to be more connected and adaptable so that they can share resources and maintain the care quality amidst the current challenges, such as resource constraints and demographic changes. Isolated and uncoordinated care services may fall short in such situations and collaborative efforts of different healthcare providers—GPs, municipality nurses, hospitals—become necessary. The identified mechanisms show that IT clearly can be a suitable tool in achieving connectivity and dynamism, but a level of managerial preparedness is required to find a way to balance between the existing service structure and the structure that can exploit the merits of IT.

This brings us to the third aspect: to what extent does the current literature prepare healthcare organizations to redesign care delivery processes that can still provide specialized services, but are more flexible and collaborative rather than siloed and rigid? It seems a management model is required that can provide knowledge and tools for successful healthcare IT deployment. As mentioned previously, while the extant literature discusses other organizational interventions, such as continuous improvement and lean, it says little about the managerial content of IT deployment. Further research is essential to find out how healthcare organizations can create care delivery processes that are in line with the requirements posed by the IT. Additionally, other research streams can investigate whether IT can be designed in a way that better fits the extant care delivery processes. The answer for this might be different for different types of IT. However, according to the findings of this thesis, the collaborative and flexible nature of IT like telemedicine is quite suitable for addressing healthcare challenges. Therefore, research that can demonstrate ways of fitting IT into the extant care delivery processes will be particularly valuable.

These aspects indicate that OM as a research discipline can contribute in ways other than its primary focus in relation to healthcare IT deployment, i.e., the prediction and measurement of the impact of IT. It can explore and identify the complementary changes of the care delivery processes triggered by different types of IT. This will be a valuable addition to the OM literature and enhance our understanding of the different processes through which performance can be improved by IT deployment. Moreover, future OM research can specify what inter- and intra-organizational efforts are required to establish those changes. By doing so, it can improve the managerial preparedness for IT deployment, thus increasing the likelihood of successful healthcare IT implementation. Consequently, OM can facilitate the redesign of care delivery processes where both specialization of each healthcare unit and collaboration among multiple units can be achieved. Lastly, this thesis reveals that IT can be used to improve both efficiency and effectiveness, depending on how the services are designed, and OM can play a crucial role in the design of service operations so that both efficiency and effectiveness can be improved.

The paradoxes and the identified complexities of healthcare IT deployment open up new research opportunities where OM can make significant contributions. Besides these, a few more specific near-future research opportunities can be mentioned that stem from the

limitations of this research and will directly extend it. Future studies can benefit from using a longitudinal research design to elaborate more on how the consideration (or lack of) of complementary changes affects the application of IT and realization of its benefits. Additionally, it will be valuable to identify if and to what extent the mechanisms of performance improvement vary for other types of healthcare IT such as electronic health record. This would broaden our understanding of the relationship between different IT functionalities and healthcare performance.

IT is not a given solution for an organization, but a dynamic one that continuously interacts with all parts of the organization and can be greatly shaped by the organization and the people working in it. Essentially, what IT deployment brings into an organization is the technical ability to do something new (e.g., monitoring patients from a distance) or doing something in a new way (e.g., providing consultations through video calls). However, the benefits can only be realized if the service design and organization structure are suitable to carry out the new operations enabled by these technologies. This understanding opens new research opportunities and possibilities to navigate IT deployment based on scientific knowledge so that the potential can be exploited and benefits can be realized. Additionally, this understanding helps us to maintain a realistic expectation from IT and places more emphasis on the roles that organizations and personnel need to play in addressing current healthcare challenges.

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Part II – Independent Articles

Paper I

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Improving healthcare operations with IT deployment: a critical assessment of literature and a framework for future research

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Abstract: In this paper, we critically assess the contribution of the operations management literature in creating pragmatic knowledge regarding how IT deployment can improve healthcare performance. A systematic literature review is conducted, and the following issues limiting knowledge generation have been identified: 1) IT deployment and healthcare performance are often conceptualised as black boxes; 2) existing theories are used inadequately, and emerging theories are lacking, which restricts the identification of the underlying mechanisms in the IT–performance relation; and 3) contextual factors are often overlooked. We develop a framework, arguing that to overcome these limitations, future studies require the following: 1) conceptualise IT in terms of its functionalities; 2) explain the reason(s) for selecting the performance attribute(s); 3) identify the mechanisms of the relationship of IT-performance by investigating and theorising the consequences of IT deployment on service operations; and 4) consider the contextual factors while explaining the IT–performance relation.

Keywords: IT; healthcare; performance; mechanism; operations management; systematic literature review; theory building; research framework; PRISMA method.

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1 Introduction

In healthcare, information technology (IT) investment is escalating across the world in an unprecedented way, here with the expectation that it can resolve the current challenges caused by diminishing resources per capita, the growing elderly population, chronic diseases and multi-morbidities (Agarwal et al., 2010; Ding et al., 2019). However, the question of how to predict and control the influence of IT deployment in improving healthcare performance remains largely unanswered, even during a period when the number of IT-related studies on healthcare is increasing at a rapid pace (Angst et al., 2011; Dobrzykowski et al., 2014; Silander et al., 2019). The literature on the relation between IT deployment and healthcare performance ranges from optimistic and enthusiastic to pessimistic and cautionary (Gardner et al., 2015). Explanations of how and why IT deployment results in improved (or not improved) performance are scant (Gastaldi et al., 2018). The research community has failed to generate systematic knowledge that could guide IT deployment in healthcare. In practice, IT investments remain driven by beliefs about – rather than evidence of – the potential of IT deployment (Rigby and Ammenwerth, 2016), which often leads to the nonadaptation and abandonment of large-scale IT investments (Greenhalgh et al., 2017). The European Union (EU) cautions that the lack of evidence of the efficacy and cost-effectiveness of IT deployment in healthcare impedes large-scale implementations (EU, 2012). Additionally, the World Health Organization (WHO) emphasises that a limited understanding of how to manage IT deployed in healthcare results in many short-lived and discrete IT

interventions that overwhelm the healthcare system (WHO, 2019). Both organisations call for normative guidelines and best practices that could help professionals deploy and manage IT in ways that benefit healthcare.

The aims of the current paper are to assess how literature on the deployment and management of technology in healthcare has explored the influence of IT on healthcare performance and to propose how the generation of pragmatic knowledge on improving healthcare performance with the support of IT can be enhanced. In the current paper, IT deployment implies "the application of information processing technology involving both computer hardware and software that deals with the storage, retrieval, sharing and use of healthcare information, data and knowledge for communication and decision making" (Thompson and Brailer, 2004, p.38). Because technology management in healthcare is a vast and multidisciplinary field, we focus on the literature within operations management (OM). As an applied discipline, OM is responsible for generating knowledge that not only advances the research field, but that also informs and supports practice (Fynes et al., 2015). Hence, we focus on pragmatic knowledge that links actions to outcomes to solve problematic conditions in the real world (Denyer et al., 2008).

A systematic literature review was conducted to create a rich and thorough account of the relevant studies (Table 1). Next, we evaluated these studies using the context–intervention–mechanism–outcome (CIMO) logic of design science research (DSR) because this logic aims to generate knowledge relevant for both theory and practice (Denyer et al., 2008). There are several issues, as will be elaborated upon later, that limit the generation of pragmatic knowledge. To remedy these issues, we propose a framework for future research, arguing that analysis of the service operations affected by IT deployment is key in generating pragmatic knowledge, which, in turn, can enhance the relevance and applicability of future studies conducted within the healthcare technology management field.

Table 1 The selected papers, year of publication and corresponding journal (the number in parentheses indicates the number of papers appearing in the journal)

Name of journal	*Papers and year of publication*	*Methodology*	
		Type of study	*Method*
International Journal of Production Economics (8)	Lillrank et al. (2002)	Empirical case study	Single case study
	Botta-Genoulaz and Millet (2006) and Tzeng et al. (2008)		Multiple case study
	Chowdhury et al. (2014)	Empirical statistical research	Data envelop analysis
	Chong et al. (2015)		ANN predictive analytic approach
	Yang et al. (2019)		Regression
	Liu et al. (2020)		
	Kochan et al. (2018)	Analytical mathematical research	Mathematical development of causal loop diagram

Table 1 The selected papers, year of publication and corresponding journal (the number in parentheses indicates the number of papers appearing in the journal) (continued)

Name of journal	*Papers and year of publication*	*Methodology*	
		Type of study	*Method*
Journal of Operations Management (8)	Li and Benton (2006), Queenan et al. (2011), Devaraj et al. (2013), Chen et al. (2013), Dobrzykowski and Tarafdar (2015), Gardner et al. (2015) and Sharma et al. (2016)	Empirical statistical research	Regression
	Bavafa and Terwiesch (2019)		Mathematical model development
Decision Science (7)	Umanath and Kim (1992), Chau et al. (2001), Edmondson et al. (2003), Yi et al. (2006), Ilie et al. (2009), Smit et al. (2013), Dobrzykowski et al. (2015); Dobrzykwoski and Tarafdar (2017)	Empirical statistical research	Regression
BMC Medical Informatics and Decision Making (5)	Sambasivan et al. (2012), Restuccia et al. (2012), Kim et al. (2016), Idoga et al. (2019); Zhou et al. (2019)	Empirical statistical research	Regression
Health Informatics Journal (5)	Escober-Perez et al. (2016); Fox et al. (2020)	Empirical case study	Single case study
	Hornyak et al. (2016)		Multiple case study
	Li et al. (2020)	Empirical statistical research	Stochastic frontier analysis
	Sittig et al. (2020)	Analytical conceptual research	Concept development
Management Science (5)	Devaraj and Kohli (2003), Bhargava and Mishra (2014), Atasoy et al. (2018); Hydari et al. (2019)	Empirical statistical research	Panel data analysis
	Greenwood et al. (2017)		Linear probability model

Table 1 The selected papers, year of publication and corresponding journal (the number in parentheses indicates the number of papers appearing in the journal) (continued)

Name of journal	*Papers and year of publication*	*Methodology*	
		Type of study	*Method*
International Journal of Operations and Production Management (5)	Procter and Brown (1997), Waring et al. (2002), Bakker et al. (2008); Drupsteen et al. (2016)	Empirical case study	Single case study
	Rubbio et al. (2019)		Multiple case study
Journal of Medical Systems (4)	Wu and Kuo (2012) and van Poelgeest et al. (2015)	Empirical statistical research	Regression
	Randeree (2007)	Empirical case study	Multiple case study
	Or et al. (2018)		Single case study
Production and Operations Management (4)	Amini et al. (2007)	Empirical statistical research	Simulation model
	Angst et al. (2011)		Dynamic program ClusterlG computer program
	Bradley et al. (2018)		General method of moment
	Laker et al. (2018)	Empirical experimental research	Controlled laboratory experiment
International Journal of Medical Informatics (3)	Green et al. (2006)	Empirical case study	Single case study
	Landis-Lewis et al. (2015)		Multiple case study
	Plantier et al. (2017)	Empirical statistical research	Regression
Journal of Healthcare Management (3)	Wurster et al. (2009) and Song et al. (2011)	Empirical case study	Single case study
	Menachemi et al. (2007)	Empirical statistical research	Regression
Business Process Management Journal (2)	Laurenza et al. (2018)	Empirical case study	Single case study
	Gastaldi et al. (2018)		Multiple case study
Decision Support Systems (2)	Menon and Lee (2000)	Empirical statistical research	Descriptive statistics analysis
	Thrasher et al. (2010)		Regression

Table 1 The selected papers, year of publication and corresponding journal (the number in parentheses indicates the number of papers appearing in the journal) (continued)

Name of journal	*Papers and year of publication*	*Methodology*	
		Type of study	*Method*
Health Information Management Journal (2)	Escobar-Rodriguez et al. (2012)	Empirical case study	Single case study
	Sharifian et al. (2014)	Empirical statistical research	Regression
International Journal of Pharmaceutical and Healthcare Marketing (2)	Bonacci and Tamburis (2011)	Empirical statistical research	Descriptive statistics analysis and interview
	Alam et al. (2019)		Regression
Supply Chain Management: International Journal (2)	Bhakoo and Chan (2011) and Xie et al. (2016)	Empirical case study	Single case study
American Journal of Managed Care	Fung et al. (2004)	Empirical statistical research	Regression
Health and Technology	Enaizan et al. (2020)		
Health Communication	Wei et al. (2020)		
Health Policy and Technology	Sezgin et al. (2017)		
IEEE Transactions on Professional Communication	Alaiad and Zhou (2017)		
Industrial Management and Data Systems	Xing et al. (2020)		
Informatics for Health and Social Care	Tavares et al. (2018)		
International Journal of Electronic Healthcare	Alsyouf et al. (2018)		
International Journal of Health Care Quality Assurance	Ford et al. (2016)		
International Journal of Information Management	Wu et al. (2016)		
International Journal of Integrated Care	Diaz-Chao et al. (2014)		
International Journal of Production Research	Mandal and Jha (2018)		
International Journal of Services Technology and Management	Tang et al. (2019)		

Table 1 The selected papers, year of publication and corresponding journal (the number in parentheses indicates the number of papers appearing in the journal) (continued)

Name of journal	*Papers and year of publication*	*Methodology*	
		Type of study	*Method*
Journal of American Medical Informatics	Ancker et al. (2015)		
Journal of Business and Industrial Marketing	Mandal (2018)		
Journal of Healthcare Engineering	van de Wetering (2018)		
Medical Care Research and Review	Kazley and Ozcan (2008)		
Organisation Science	Gardner et al. (2017)		
Plos One	Benedictis et al. (2020)		
Total Quality Management	Wu and Hsieh (2011)		
Healthcare Management Science	Williams et al. (2016)		Data envelop analysis
Telemedicine and E-Health	Galimany-Masclans et al. (2011)		Descriptive statistics analysis and t-test
International Journal of Logistics Management	Feibert and Jacobsen (2019)	Empirical case study	Multiple case study
Journal of Decision Systems	Alohali et al. (2020)		Single case study
Journal of Health Organization and Management	Wu et al. (2016)		
Journal for Healthcare Quality	Russell et al. (2010)		
Production Planning and Control	Wamba and Ngai (2015)		Single case study (Delphi technique)
BMJ Quality and Safety	Singh et al. (2016)	Analytical conceptual research	Concept development
Journal of Service Management	Mithas et al. (2020)		
JMIR Medical Informatics	Williams et al. (2019)		

The rest of the present paper is organised as follows: First, we develop the research framework and questions, which will guide the rest of the study. Second, the methodology of the systematic review is described, along with the evaluation and

synthesis of the papers. Next, the findings are presented, which is followed by a framework for future research. The final section explains the implications and limitations of the study.

2 Research approach and research questions

The current context of healthcare IT management indicates that we need a systematic development of pragmatic knowledge to manage and regulate IT deployment in healthcare. Therefore, the current paper has two aims:

1 to assess the literature and identify how studies are contributing to the development of knowledge

2 to propose how the contributions of future studies can be improved.

A framework that could assess all of the relevant aspects of the current studies was developed by applying CIMO logic from DSR (Denyer et al., 2008). DSR aims to develop generic design propositions that enhance the pragmatic validity of a study and develop a general understanding of the underlying mechanism that produces a certain outcome. The purpose of the DSR approach is in line with our purpose of reviewing the literature: to identify how the OM literature has contributed to generating pragmatic knowledge while studying the outcome of IT deployment in healthcare. Thus, the CIMO logic has provided us with a scientifically reasoned schema for assessing the literature and has been applied to assess the status of the OM literature, specifically IT deployment in healthcare.

The CIMO logic seeks the generative mechanism (M) through which an intervention (I) results in an outcome (O) in a given context (C). According to DSR, the context refers to external and internal environmental factors, including human actors; intervention refers to the set of actions that managers/organisations have at their disposal to influence behaviour; mechanism refers to the basic explanation of why certain outcomes emerge in a given context; and outcome refers to the consequences of the intervention in its various aspects. Because the CIMO logic enables research studies to generate pragmatic knowledge, which aligns with the aim of the present paper, we use the dimensions of CIMO to frame our research questions. Following the first aim of the current study, we pose the first research question (RQ): How has IT deployment been studied in relation to the performance of the healthcare system? Next, we divide this overarching RQ into four specific RQs, reflecting the four dimensions of CIMO, that is, context, intervention, mechanism and outcome. Thus, we assess how the context of IT deployment has been taken into consideration, how IT interventions are conceptualised, what the performance attributes, here measured as the outcome of the IT deployment, are, and how the mechanisms of improving performance through IT deployment have been identified in the literature. Thus, the first RQ focuses on assessing the current literature, whereas the second RQ focuses on how future studies can better contribute pragmatic knowledge on healthcare IT deployment. Below is a list of the RQs. and Figure 1 represents the research framework reflecting the RQs and their connection with the literature review.

1 How has IT deployment been studied in relation to the performance of the healthcare system?

1.1 How is the context taken into consideration in these studies?

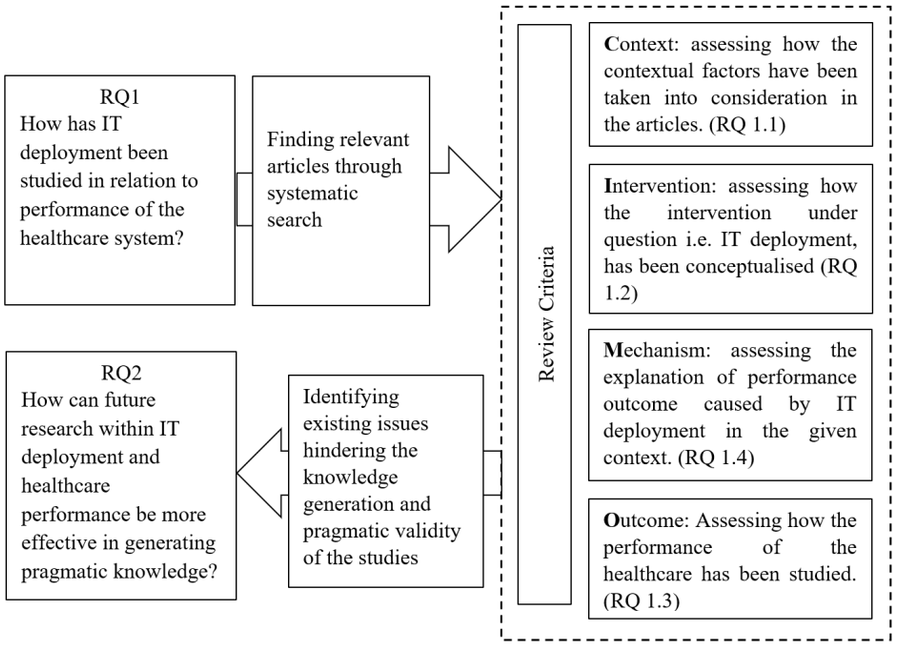
1.2 How do these studies conceptualise IT deployment in healthcare?

1.3 What are the performance attributes and other variables influenced by IT deployment?

1.4 What are the theories or mechanisms that have emerged or were tested in the studies?

2 How can future research on IT deployment and healthcare performance be more effective in generating pragmatic knowledge?

Figure 1 Research approach



3 Methodology

We followed the stages of a systematic literature review as proposed by Tranfield et al. (2003) to conduct a replicable, scientific and transparent study. The first two stages – *planning* and *conducting the review* – are discussed in this section, whereas the final stage – *reporting and dissemination* – is discussed in the findings section.

3.1 Planning the review

The research questions of the review and the framework against which the papers will be assessed have been presented in the previous section. The next step we took was to outline the scoping of our study, where the relevance of the literature was assessed and the subject areas delimited (Tranfield et al., 2003). The multidisciplinary field of healthcare technology management has been studied by looking at various scientific disciplines outside of the field of OM, such as information system (IS), organisations study (OS) and medical science (MS). Therefore, careful framing of OM and the identification of the characteristics that make a paper belong to OM is important. The coauthors analysed definitions of OM found in books (Jacobs et al., 2009; Meredith and Shafer, 2013; Reid and Sanders, 2013; Slack et al., 2004; Stevenson, 2014; Wild, 2002), along with looking at the aim and scope of OM in the editorials of various OM journals (e.g., *Decision Sciences Journal*, *International Journal of Operations and Production Management*, *International Journal of Production Economics*, *Journal of Operations Management*, *Journal of Supply Chain Management*, *Production and Operations Management*, *Production Planning* and *Control, Supply Chain Management: An International Journal)* and several papers that map OM's research focus and contributions.

It became apparent that the boundaries of OM are indeed difficult to define (Voss, 1995). OM has an unusually high degree of interaction with other subject areas, and theoretical models and analytical tools have often been attributed to competing fields of study (Pilkington and Fitzgerald, 2006; Slack et al., 2004). However, the three sources mentioned above gave a fairly consistent picture of OM's main purposes:

- improve the performance level of ongoing operations, services and processes
- make the integration and coordination among the actors (e.g., producers of goods and services, suppliers, consumers and other stakeholders) within the value chain more efficient
- plan and control the value creation processes more effectively.

This framing of OM guided the review process, both in creating the search strings and in selecting relevant papers.

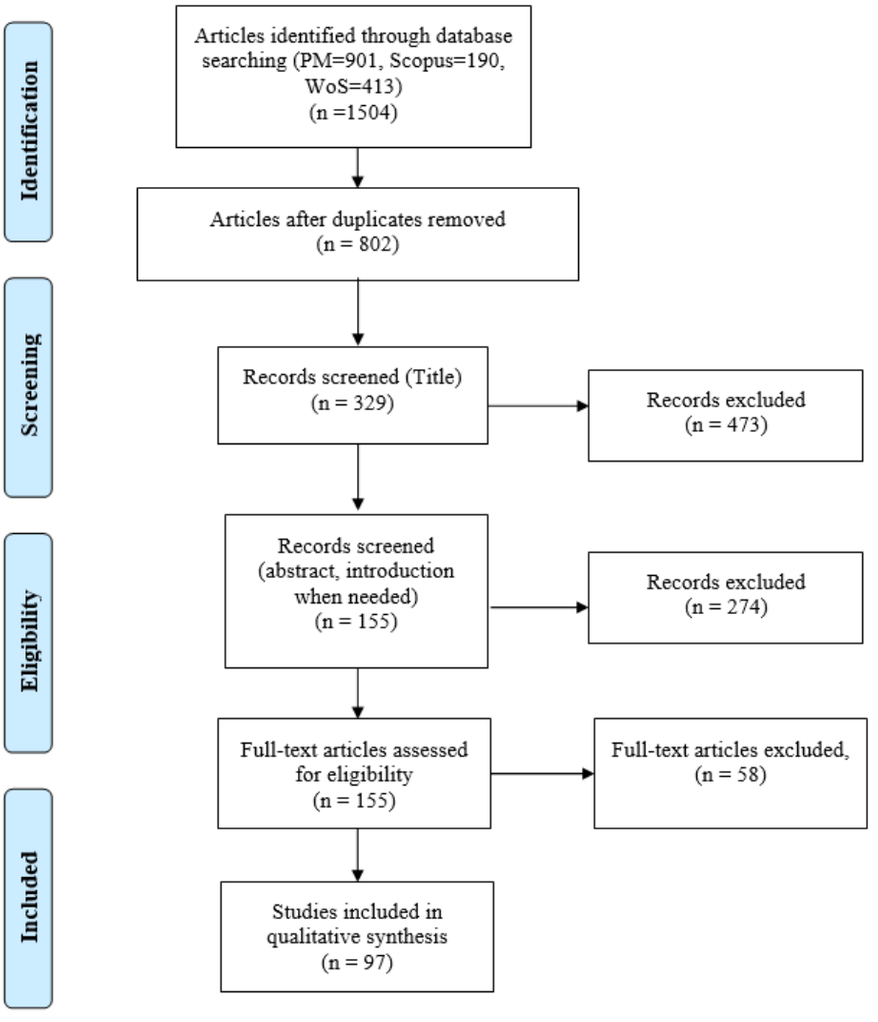
3.2 Conducting the review

To select the relevant studies, we followed the steps of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework (Liberati et al., 2009). This is consistent with the systematic review approach by Tranfield et al. (2003), which provides a step-by-step guideline for selecting papers. The paper selection process is shown in Figure 2.

The databases used for the literature search were PubMed (PM), Web of Science (WoS), and Scopus. The keywords used for the search were as follows: digital*or technolog* or electronic* or information or eHealth or ICT, and supply chain OR operations OR process OR management OR integrat* OR coordinat* OR performance OR service OR system OR planning OR control OR logistics, and health* OR hospital. This string was adjusted according to the advanced search options of the respective databases. Papers published until September 2020 were included, and the oldest paper

found in the search was 1992. In total, 1504 papers were gathered from all the databases mentioned above and exported to Endnote for further processing. After removing duplicates, 802 papers remained.

Figure 2 The paper selection process following the PRISMA framework (see online version for colours)



The exclusion criteria were predefined by the authors and revised several times because papers from different fields showed up in the search results. We grouped the exclusion criteria into the following categories: papers primarily focusing on the

1 design or development of technology

2 procurement of technology

3 guidelines and research protocol for clinical trials

4 survey questionnaire design

5 healthcare insurance

6 application of data extracted from different technologies (e.g., electronic health record (EHR)) to answer treatment/drug/diagnosis related questions

7 financial, accounting and legal perspectives.

In addition, only journal publications were included to ensure the quality of the papers (David and Han, 2004). The papers were screened in two stages: title screening, which left us with 329 papers, and abstract screening, which resulted in 155 papers for full-text reading.

3.3 Data extraction and an overview of the selected papers

A data extraction form (Tranfield et al., 2003) was created in an Excel spreadsheet, consisting of the following categories: name of the journal, purposes and research questions; context (which country, what types of healthcare organisation, etc.); methodology; performance attributes; types of IT being studied; and, contributions and implications of the study. The aim was to collect rich data about each paper. During the reading of the full papers, several papers that seemed to be falling outside the scope of this review were identified. In these occasions, at least two of the coauthors had independently assessed the contributions of these papers and compared them with our framing of OM. Next, they presented their individual assessment on whether to include or exclude the papers; final decisions were jointly made to reduce the implicit biases of individual authors (Tranfield et al., 2003). At the end of these processes, 97 papers were selected for further analysis. The data extraction, including categorised summaries of 97 papers, was used as the primary database, but we also revisited the papers frequently to read the content when necessary. We conducted two types of analysis for the final 97 papers:

1 descriptive analysis, as presented in this section, which involves the assessment of formal dimensions of the papers, such as publication trends and methodological preferences in journals (Dobrzykowski et al., 2014)

2 content analysis, in which the papers were analysed based on the research approach (Figure 1).

Chi square testing demonstrates steady growth in the number of publications in this field from 1992 to September 2020 (Figure 3). This finding corroborates Dobrzykowski et al.'s (2014) findings in their literature review of healthcare OM, stating that studies relating to IT deployment in healthcare are burgeoning within the OM field. The Chi square test also confirms that the number of publications in this field has been increasing significantly over time ($T = 9.46$, $P < 0.05$).

Next, we evaluated the journals in relation to their methodologies and to the journals in which they were published. We borrowed the classification of methodologies used by Wacker (1998), which distinguishes among analytical conceptual research, analytical mathematical research, analytical statistical research, empirical experimental research, empirical statistical research and empirical case study. Moreover, we analysed the particular methods used by the papers to understand whether a predominant method

exists. Table 1 presents an overview of the papers and journals in which they were published, their year of publication and the methodology used.

Figure 3 Growth in the number of published papers on IT deployment in healthcare OM

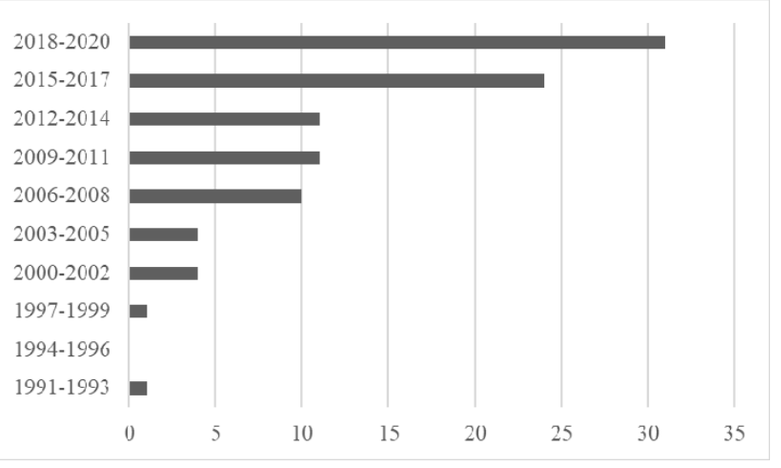


Table 2 shows that most of these studies are empirical statistical research (66%), among which regression analysis (44%) is by far the most prevalent research method applied. The second most used method is multiple and single case studies (28%). However, we could not find any time-dependent trends for any of the methodologies; for example, empirical statistical research has constantly been the most popular research methodology, and empirical case studies are also scattered evenly throughout the time period.

Table 2 Percentage of reviewed papers by study-type category

*Type of study**	*Number of papers*	*Percentage*
Empirical statistical research	64	66
Empirical case study	27	28
Empirical experimental research	1	1
Analytical conceptual research	4	4
Analytical mathematical research	1	1
Total	97	100

*No paper was found in the category of analytical statistical research.

4 Findings

This section outlines the findings of the literature review in terms of the context, conceptualisation of IT deployment, performance and mechanisms (Figure 1). The section ends by explaining the issues limiting the generation of pragmatic knowledge within the domain.

4.1 Context: the factors impacting the IT-performance relationship

In several papers, we identify a growing tendency to consider the context while assessing the impact of IT, particularly in the papers in the empirical case study research category. The authors of these studies have suggested that the influence on performance cannot be attributed to IT deployment alone because there are many other factors simultaneously present in the system. The adoption and implementation of IT are affected by factors such as supply chain structure, internal readiness (Bakker et al., 2008) and cultural differences in perception between the different units of an organisation (Procter and Brown, 1997). Contrary to the prevailing notion that the application of IT in an organisation is a technical process, some authors have proposed that it is also a social and political process where a change in work practices, internal staff adequacy, training, top management support and historical underpinning should be considered (Botta-Genoulaz and Millet, 2006; Russell et al., 2010; Waring and Wainwright, 2002; Wurster et al., 2009; Sousa et al., 2021). Emphasising the role of the overall context in healthcare performance, Green et al. (2006) argue that IT is one of the critical success factors, including organisational partnership, funding mechanism, practice models and knowledge translation practices. Studies from the analytical mathematical (1) and conceptual (2) categories also incorporated contextual factors into their models (Kochan et al., 2018; Singh and Sittig, 2016; Williams et al., 2019).

Regarding papers from the empirical statistical and experimental research categories, which constitute 69% of the papers reviewed here, only 21 out of 65 studies use either independent variables or control variables that represent contextual factors. The independent variables include hospital location and size, investment in technology, nursing staff training, nurse competence, job enlargement and sharing (Li and Benton, 2006), trust, knowledge exchange (Chen et al., 2013) and length of stay (Devaraj et al., 2013); and the control variables include teaching status, bed size (Dobrzykowski and Tarafdar, 2017; Wu et al., 2016), hospital size, case mix index, teaching orientation (Sharma et al., 2016), maturity of technology, number of staffed beds, location of hospital, year hospital opened (Angst et al., 2011), trust and collaboration (Bhakoo and Chan, 2011) and organisational commitment (Russell et al., 2010). These statistical studies, however, rarely explain why certain contextual factors are chosen as control variables instead of independent, mediating or moderating variables and whether prior analyses have been performed to prove that these factors do not have causal relationships with the other variables in the model – such treatment of the control variables weakens the reliability of a study (Williams et al., 2009).

Identifying the contextual factors and addressing them systematically to understand how they influence the relationship between IT deployment and the performance of any organisation is important (Ho et al., 2002; Zhang et al., 2011). However, the studies do not fully adopt this practice. In summary, empirical case studies are generally inclined to use context as a key measure in their studies, while the methodologies of empirical statistical and experimental studies require a constrained treatment of contextual factors in the analyses (Meredith, 1998). In the studies that analyse context, we could not find any consensus on the factors that are the most likely to impact the relation between IT deployment and healthcare performance.

4.2 Intervention: conceptualisation of IT deployment

Studies within the domain of IT deployment and healthcare performance have used many different terminologies, such as IT (Devaraj et al., 2013; Drupsteen et al., 2016; Li and Benton, 2006; Menon and Lee, 2000; Thrasher et al., 2010; Wu and Kuo, 2012), health information technology (HIT) (Dobrzykowski and Tarafdar, 2017; Singh and Sittig, 2016; Williams et al., 2019), digital technology (Gastaldi et al., 2018; Laurenza et al., 2018) and hospital technology (Li and Benton, 2006). Although Koumaditis and Hussain (2018) mention the unclear themes and blurred lines between perception, realisation and outcome that exist in the EHR literature, our study shows that the vast body of literature on healthcare technology follows a similar pattern. The variety of terms and lack of a prominent definition of the concept obstruct a comprehensive view of the studies within this domain; for example, we had to consciously accumulate various keywords while searching for papers to minimise the likelihood of missing a relevant paper. The different types of IT studied in the papers are listed in Table 3.

Furthermore, 37 out of 97 (38%) papers do not mention any particular technology. Instead, they use IT as an abstract concept but hardly outline the constructs or definition. Although these studies describe the effect of IT deployment in general, studies focusing on particular IT deployments provide insights into how these types of IT could guide practitioners in adopting IT. A few studies delve into the functionalities of the IT being studied; for example, Li et al. (2020) list clinical documentation, testing and imaging results, computerised provider order entry and decision support (i.e., clinical guidelines and reminders, drug–allergy alerts and drug–drug interaction as the functions of EHR that they have studied). The studies by Kazley and Ozcan (2008) and Plantier et al. (2017) list different groups of functionalities of EHR, eventually showing that different functionalities have different impacts on the performance attributes. Such analyses provide more specific information about the IT under study and its influence on performance than studies that do not analyse these functionalities. In addition, we can infer from these three studies that even a particular IT has many functions, and different hospitals choose different types.

In brief, the conceptualisation of IT deployment exhibits two common patterns: first, most of the studies focusing on particular IT do not point out the functions these IT perform; second, some studies use IT as an abstract concept but do not define or explain what constitutes IT. Overall, the conceptualisation of IT lacks clarity, which adversely affects the external validity of the studies (Yin, 2018).

4.3 Outcome: attributes of healthcare performance

The common performance attributes found in the papers (the attributes used in more than one study) are listed in Table 4. We could not group the performance attributes according to particular IT such as EHR, CPOE, EDI or RFID. This indicates that our knowledge on the relationships between these IT and performance is still in an explorative stage. Although a wide range of attributes have been used in different studies, only a few justify and explain the reason for choosing certain performance attributes (e.g., Li and Benton, 2006; Laker et al., 2018). Furthermore, different studies use different scales to measure the same attribute, which challenges both the construct and external validity (Yin, 2018).

For example, different papers use different expenditures to measure cost, which confounds the concept of cost as a construct and reduces the generalisability of the outcome. Finally, attributes from different levels of aggregation, for example, length of stay and mortality, have been used in the same model, where the effect on the former is more quickly realised while the second may take years. Combining different levels of aggregation reduces a model's ability to explain the effect (Beer, 1972).

Table 3 List of papers that mention particular technologies (the number in parentheses indicates the number of papers studying the type of IT)

Type of IT	*Papers*
Electronic health record (EHR), electronic medical record, electronic patient record (24)	Randeree (2007), Kazley and Ozcan (2008), Ilie et al. (2009), Bonacci and Tamburis (2011), Galimany-Masclans et al. (2011), Song et al. (2011), Smith et al. (2013), Bhargava and Mishra (2014), Ancker et al. (2015), Dobrzykowski and Tarafdar (2015), Landis-Lewis et al. (2015), van Poelgeest et al. (2015), Ford et al. (2016), Kim et al. (2016) Williams et al. (2016), Laker et al. (2018), Plantier et al. (2017), Alsyouf et al. (2018), Atasoy et al. (2018), Or et al. (2018), Tavares et al. (2018), Hydari et al. (2019), De Benedictis et al. (2020) and Enaizan et al. (2020)
Radio frequency identifier (RFID) (8)	Amini et al. (2007), Tzeng et al. (2008), Bhakoo and Chan (2011), Chong et al. (2015), Wamba and Ngai, (2015), Hornyak et al. (2016), Bradley et al. (2018) and Tang et al. (2019)
Information sharing system (5)	Procter and Brown (1997), Waring et al. (2002), Sharifan et al. (2014), Kochan et al. (2018) and Zhou et al. (2019)
Online consultation (5)	Diaz-Chao et al. (2014), Bavafa and Terwiesch (2019), Yang et al. (2019), Liu et al. (2020) and Xing et al. (2020)
Decision support system (DSS) (3)	Devaraj and Kohli (2003), Sambasivan et al. (2012) and van de Wetering (2018)
Group of health information technology (3)	Russell et al. (2010), Sharma et al. (2016) and Rubbio et al. (2019)
Medical technology (3)	Edmondson et al. (2003), Angst et al. (2011) and Greenwood et al. (2017)
Computerised physician order entry (CPOE) (2)	Queenan et al. (2011) and Escobar-Rodriguez et al. (2012)
Enterprise resource planning (ERP) (2)	Botta-Genoulaz and Millet (2006) and Escobar-Perez et al. (2016)
Fitness mobile app	Wei et al. (2020)
Web-based chronic disease management toolkit	Green et al. (2006)
Personal digital assistant (PDA)	Yi et al. (2006)
Computerised clinical reminders	Fung et al. (2004)
IT-based referral system	Lillrank et al. (2002)

Table 4 Performance attributes used in the empirical papers

Performance category		*Papers*
Patient related	Satisfaction, quality of care, mortality, continuity of care, patient safety, reliability (22)	Xing et al. (2020), Tang et al. (2019), Gardner et al. (2017), Plantier et al. (2017), Ford et al. (2016), Sharma et al. (2016), Williams et al. (2016), Wu et al. (2016), Ancker et al. (2015), Dobrzykowski and Tarafdar (2015), Gardner et al. (2015), van Poelgeest et al. (2015), Diaz-Chao et al. (2014), Devaraj et al. (2013), Wu and Kuo (2012), Galimany-Masclans et al. (2011) ; Queenan et al. (2011), Thrasher et al. (2010), Wu and Hsieh (2011), Kazley and Ozcan (2008), Menachemi et al. (2007), Li and Benton (2006) and Devaraj and Kohli (2003)
Practitioner related	Constructs of different technology adoption models, e.g., TAM, UTAUT (17)	Enaizan et al. (2020), Wei et al. (2020), Alam et al. (2019), Idoga et al. (2019), Tang et al. (2019), Zhou et al. (2019), Alsyouf et al. (2018), Tavares et al. (2018), Yang et al. (2018), Alaiad and Zhou (2017), Sezgin et al. (2017), Kim et al. (2016), Chong et al. (2015), Sharifian et al. (2014), Sambasivan et al. (2012), Ilie et al. (2009) and Chau et al. (2001)
	Decision making (4)	van de Wetering (2018), Greenwood et al. (2017), Laker et al. (2018) and Umanath and Kim (1992)
	Physicians' engagement	Liu et al. (2020)
	Working hour	Bavafa and Terwiesch (2019)
Organisation related	Cost and revenue (12)	Li et al. (2020), Bradley et al. (2018), Gastaldi et al. (2018), Hornyak et al. (2016), Sharma et al. (2016), Chen et al. (2013), Devaraj et al. (2013), Smith et al. (2013), Wu and Kuo (2012), Thrasher et al. (2010), Li and Benton (2006) and Devaraj and Kohli (2003)
	Readmission (4)	Bradley et al. (2018), Williams et al. (2016), Angst et al. (2011) and Thrasher et al. (2010)
	Learning and innovativeness for IT use (4)	Xie et al. (2016), Wu and Hsieh (2011), Yi et al. (2006) and Edmondson et al. (2003)
	Average length of stay (3)	Angst et al. (2011), Thrasher et al. (2010) and Menon and Lee (2000)
	Inventory related (2)	Kochan et al. (2018) and Chen et al. (2013)
	Medication error (2)	Escobar-Perez et al. (2016) and Escobar-Rodriguez et al. (2012)
	Availability of service/function (2)	Wu and Kuo (2012) and Fung et al. (2004)

4.4 Mechanism: generation of explanation and knowledge

This section focuses on how existing theories have been applied to explain the relationship between IT deployment and healthcare performance and on how theories

have emerged or been extended from these observed relations. Both the emergence of new theory and application of existing theory can explain the relationship and contribute to the generation of knowledge (Oliva, 2019; Walker et al., 2015). We have mapped the theories, models or literature domains used in the studies (Table 5). The models related to technology adoption, such as the technology acceptance model (TAM) and unified theory of acceptance and use of technology (UTAT), are by far the most used. A few of the papers extend these models by adding new aspects, such as personality traits (Chong et al., 2015), top management support and continuance intention (Alsyouf and Ishak, 2018) or physical and logical accessibility (Ilie et al., 2009).

Table 5 Theory/model/literature used in the studies (the number in parentheses represents the number of papers using the theory or framework)

Theory/model/literature	*Paper*
Technology adoption model (TAM, UTAT) (19)	Chau et al. (2001), Yi et al. (2006), Ilie et al. (2009), Sambasivan et al. (2012), Sharifian et al. (2014), Chong et al. (2015), Kim et al. (2016), Alaiad and Zhou (2017), Sezgin et al. (2017), Alsyouf et al. (2018), Tavares et al. (2018), Alam et al. (2019), Feibert and Jacobsen (2019), Idoga et al. (2019), Tang et al. (2019), Zhou et al. (2019), De Benedictis et al (2020), Enaizan et al. (2020) and Wei et al. (2020)
Resource-based view and related theories (5)	Thrasher et al. (2010), Chen et al. (2013), Bradley et al. (2018), Mandal and Jha (2018) and van de Wetering (2018)
Information processing model (4)	Umanath and Kim (1992), Lillrank et al. (2002), Gardner et al. (2015) and Dobrzykwoski et al. (2017)
Coordination and interdependence theory (3)	Thrasher et al. (2010), Dobrzykowski and Tarafdar (2015) and Dobrzykwoski et al. (2017)
Business process management (2)	Laurenza et al. (2018) and Feibert and Jacobsen (2019)
System theory (2)	Wu et al. (2016) and Kochan et al. (2018)
Structure-process-outcome model (2)	Kazley and Ozcan (2008), Wu and Hsieh (2011)
Task-technology fit (2)	Bhargava and Mishra (2014) and Devaraj and Kohli (2003)
User resistance theoretical model	Alohali et al. (2020)
Institutional theory	De Benedictis et al. (2020)
Shared mental model theory	Fox et al. (2020)
Literature on gamification	Liu et al. (2020)
Interpretive model of technology	Mithas et al. (2020)
Justice theory, SERVQUAL	Xing et al. (2020)
Multichannel service delivery, professional service organisation	Bavafa and Terwiesch (2019)
Theory of dynamic capabilities	Rubbio et al. (2019)
Capability maturity model	Williams et al. (2019)
Top management support (TMS)	Alsyouf et al. (2018)

Table 5 Theory/model/literature used in the studies (the number in parentheses represents the number of papers using the theory or framework) (continued)

Theory/model/literature	*Paper*
Exploration exploitation theory of organisation	Gastaldi et al. (2018)
Literature on organisational mindfulness	Gardner et al. (2017)
Technology adoption and abandonment	Greenwood et al. (2017)
Literature on advanced manufacturing technology	Sharma et al. (2016)
Technology–organisation–environment framework	Xie et al. (2016)
BIG 5 (personality trait)	Chong et al. (2015)
Theory of swift even flow	Devaraj et al. (2013)
IT governance	Smith et al. (2013)
Balanced score card	Wu and Kuo (2012)
Process model, Prevention appraisal failure model	Queenan et al. (2011)
Business process engineering	Tzeng et al. (2008)
Knowledge management	Edmondson et al. (2003)
Critical social theory	Waring et al. (2002)
Econometric model	Menon and Lee (2000)
Computer-integrated manufacture (CIM) framework	Procter and Brown (1997)

Apart from the extension of different TAMs, no other extension or emergence of theory could be identified. Most of the studies are deductive in nature – that is, hypotheses are developed based on a certain set of the literature (e.g., information processing model) and tested. Most of the studies describe the relationship among the dependent and independent variables based on existing findings that are relevant to the study's research questions. However, they do not explain why such relationships are thought to occur; thus, they cannot be considered as testing or developing theory (Sutton and Staw, 1995). One of the few papers that explicitly uses theory is Bhargava and Mishra (2014), which uses task-technology fit theory to explain the temporal and dynamic impact of EMR on physicians' productivity, postulating that depending on the specialties of the physician, the impact of EMR on the physician's productivity would be different (Bhargava and Mishra, 2014). Moreover, we have identified that hardly any paper pinpoints the effect of IT deployment on service operations within the healthcare system, even though the changes in performance level are inevitably the aftermath of changes in operations within the care delivery process (Donabedian, 1966; Hung et al., 2019). Although a few authors have discouraged drawing a direct link between IT deployment and performance (Devaraj and Kohli, 2003), the tendency to draw such a direct link prevails in the literature. We consider this to be a major barrier to the generation of pragmatic knowledge because the search for direct links ignores the underlying mechanisms.

We also find inconsistent relationships among similar variables in different studies. For example, whereas some papers have found positive effects of IT deployment in

relation to information availability, such as IT improving the quality of patient records, reducing delays in communication (Plantier et al., 2017), improving demand visibility, improving lead time, improving service (Kochan et al., 2018) and reducing hospital admission and mortality rate (Thrasher et al., 2010), other papers discuss the risk of information overloading because of the application of IT, which could end up delaying decision making (Laker et al., 2018) or negatively affecting the quality of decisions, thereby risking patient safety (Ford et al., 2016). Similarly, IT has been discussed, on the one hand, as one of the antecedents of integration in healthcare systems (e.g., Drupsteen et al., 2016), yet on the other hand, IT is said to be mediated by hospital integration (e.g., Chen et al., 2013). Thus, some studies propose that integration is enhanced by the application of IT; others conclude that integration is needed to realise the positive effects of IT.

Inconsistent empirical relationships do not necessarily have to result in ambiguity. When accompanied by the underlying mechanisms that explain under which circumstances these relationships are observed and why, these inconsistencies can contribute to a greater understanding of the domain. For example, one possible explanation of such an inconclusive relation is that the influence of IT deployment varies over time – for example, it is moderated by the coordination situation of healthcare in the initial stage of deployment, and it strengthens the coordination during the mature stage of deployment. In brief, scant use of theory, both in terms of applying existing theories and developing new ones, along with the neglect of changed service operations, are predominant in the literature. Such research traditions can be seen as the cause for the inadequate explanation of the relationship between IT deployment and healthcare performance, which hinders pragmatic knowledge generation.

4.5 Status quo of literature on IT deployment and healthcare performance

A summary of the findings is presented in Table 6, with exemplar papers being given that best illustrate the respective assessment criteria.

These current research practices reduce the ability of knowledge creation in several ways. First, the lack of contextual consideration limits the external validity (Wacker, 1998). Next, studying IT as a black box – a device that is described simply in terms of input and output, while its contents, structure and origin are neglected for convenience (Winner, 1993) – can only observe and describe the effect of IT deployment on performance; it cannot explain and control that effect and is discouraged in both the OM and IS fields (e.g., Dobrzykowski and Tarafdar, 2017; Orlikowski and Iacono, 2001). Similarly, overlooking the consequences of IT deployment on service operations results in inconsistent conclusions, contributing to the unpredictability around IT deployment.

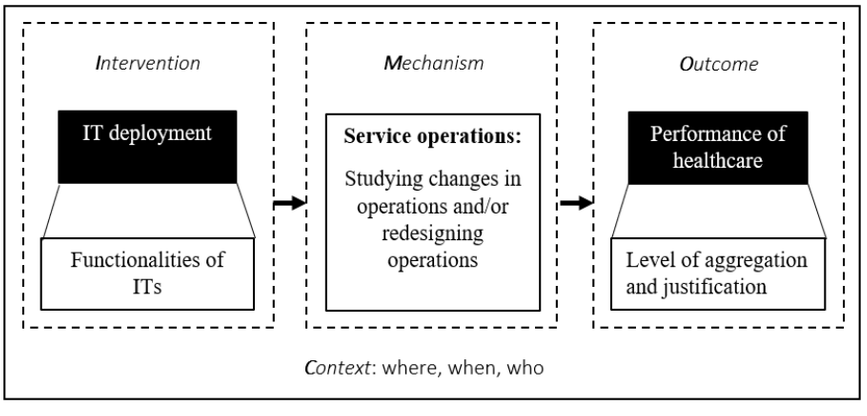
5 Framework for future research

Based on the assessment above, we propose a framework (Figure 4) for future research. The framework amends the identified issues in the literature that limit the generation of pragmatic knowledge.

Table 6 Status quo of literature on IT deployment and healthcare performance

Assessment criteria of the studies	*Assessment*	*Exemplar papers*
Context (C)	Few studies consider the contextual impact regarding the relationship between IT deployment and performance. A large number of studies are imprecise in stating where and when the results of the study are valid, applicable and reproducible	Li and Benton (2006) and Waring and Wainwright (2002)
Conceptualisation of IT deployment (I)	The papers mostly lack a definition of the constituents of IT as a concept and a demonstration of the functionalities or capabilities of the particular IT	Kazley and Ozcan (2008) and Plantier et al. (2017)
Explanation of relation between IT deployment and healthcare performance (M)	The studies largely overlook the influence of IT deployment on the service operations of the care delivery process, thereby lagging in their explanation of the relation between IT deployment and healthcare performance	Bhargava and Mishra (2014) and Devaraj et al. (2013)
Performance attributes (O)	Attributes from different levels of aggregation are measured simultaneously, and no justification for selecting these attributes is provided	Lillrank et al. (2002) and Dobrzkowsky et al. (2017)

Figure 4 Framework for future research on IT in healthcare OM



5.1 Opening the black box of IT

We propose that IT must be studied in terms of its functionality so as to understand how and why IT deployment leads to particular performance changes. Functionality specifies what IT does or provides to support or accomplish tasks when set up in an organisational context (Dishaw and Strong, 1999; McNamara and Kirakowski, 2006). Without considering the functionalities of IT, one cannot frame the mechanisms of performance improvement, and the real scope of IT – whether it is to measure or control biological parameters or enhance communication or trigger and support behaviour – will remain

vague (Colucci, 2015). The importance of studying the functionalities of IT to understand its influence has been discussed in both the IS and OS fields, showing that without clarifying the content and properties of a piece of technology, the knowledge of it and its influence on organisations remain incomplete (e.g., Kallinikos et al., 2013; Orlikowski and Iacono, 2001). The Healthcare Information and Management Systems Society (HIMSS) recognises that healthcare IT such as EHR comprises multiple functions, and different hospitals adopt a different range of these functionalities (HIMSS, 2006). Therefore, researchers should be more specific than mentioning the name of IT while analysing its effect.

There are a few studies that classify healthcare ITs using different categories, including time of innovation and area of focus (Gastaldi et al., 2018; Oueida et al., 2018; Tortorella et al., 2020). A comprehensive classification of healthcare IT based on functionality could not be found in the literature. However, following the classification proposed by Oueida et al. (2018) and supported by Tortorella et al. (2020), we have classified healthcare IT found in the current review study into two groups: clinical IT and administrative IT. Clinical IT can refer to IT explicitly used for patient treatment and administrative IT for managerial activities that support the treatments. Table 7 provides an overview of the classification, including the functionalities and examples from literature.

Table 7 Classification of healthcare IT according to their functionalities

Generic classification of healthcare IT	*Functionalities*	*Examples*
1. Clinical IT	• Assists the practitioners to detect, measure and treat patients' conditions • Real-time transmission of audio-visual and numerical data between practitioners and patients • Receives, stores, analyses, visualises and shares data among healthcare personnel and patients	Automatic blood sugar meter, surgical technology, PDA, CPOE, remote consultation, web-based or app-based disease management toolkit
2. Administrative IT	Receives, stores, analyses, visualises and shares data among healthcare personnel and patients and healthcare management	EMR, EHR, RFID and ERP

As can be seen from Table 7, there are functional overlaps between these two groups of IT, so future research is required to create a comprehensive classification of healthcare IT based on its functionalities. Moreover, whereas Table 7 exhibits generic healthcare IT functionalities, studies focusing on a particular IT can dive into more specific functionalities. For example, in their research on EHR application, Plantier et al. (2017) study electronic drug prescriptions, discharge records and care records as the functions of EHR. The merit of such analysis is that it informs the future design and implementation of the particular IT, enabling users to delineate their expectations of that IT. These features can explain ambiguities, such as why some hospitals are more successful in

implementing and using IT than others and why some ITs are quickly abandoned by practitioners. Therefore, we propose the following:

Proposition 1: *Studies conceptualising IT in terms of functionalities will better explain the relation between IT deployment and healthcare performance.*

5.2 Studying the consequences of IT deployment through changes in service operations

We propose studying the consequences of IT deployment on service operations to discover the causal links between IT deployment and performance. Operations are sequences of events and actions involving time and organisational resources, and they result in particular outcome(s) (Fynes et al., 2015). Service operations consist of all the direct and indirect operations taking place in a healthcare context to treat patients. The lack of a clear understanding of how new IT can change the clinical workflow can negatively affect the deployment of IT in healthcare (Mora, 2012). Moreover, Sambamurthy et al. (2003) posit that IT deployment influences a firm's performance through organisational capabilities and strategic processes. Similarly, we contend that changes in healthcare performance can only be inferred through changes in ongoing service operations because of IT deployment.

The mechanisms of performance changes can be identified by analysing aspects such as how the use of new IT affects the patients and material flow; how demand variability can be controlled or predicted by real-time information access and its implication for planning and control; how bottlenecks are revealed and treated; how the decision-making process is changed and shifted to another service unit or personnel; how the requirement for new skills emerges; and how patients' involvement and care coordination are reshaped. A case in point is the study on the effect of e-visits by Bavafa and Terwiesch (2019), in which the authors examine how e-visits influence the work content of physicians' practices, thus providing deeper insights into technology use in the healthcare context.

Moreover, IT deployment may result in unintended changes. For example, a recent study shows how incorporating new IT systems into healthcare leads to confusion among care providers, leading to disruption in operations (Brodersen and Lindegaard, 2015; Qian et al., 2019). These unintended effects of IT deployment on performance cannot be identified without studying changes in service operations. On the one hand, the decomposition of IT into its functions will inform researchers about which operations in the healthcare system are likely to be affected by IT application. On the other hand, the identification of these operations will inform researchers about which performance attributes are the most relevant for measuring the effects. The second proposition states the following:

Proposition 2: *Studies identifying the consequences of IT deployment for service operations will better explain the mechanism(s) of the IT deployment and healthcare performance relationship.*

5.3 Opening the black box of performance

We propose that performance attributes should be chosen rationally based on the functionalities of IT and consequences of deployment for service operations. Healthcare organisations use various clinical (e.g., quality adjusted life year), processes (e.g., waiting list), and financial (e.g., cost per bed) attributes to measure performance. The reasons for choosing certain attributes from this wide array of performance measures also need to be clearly explained so that the underlying logic can be reused or improved in future studies. In addition, selecting attributes arbitrarily or because of practical convenience, such as the availability of a certain database for some performance measures, may not capture the actual effect of IT deployment, leading to imprecise, even misleading, conclusions in a study (Lillrank et al., 2002). Therefore, we propose the following:

Proposition 3A: *Studies selecting the performance attributes based on the functionalities of IT and its consequences for service operations will better explain the relationship between IT deployment and healthcare performance.*

The level of aggregation in performance attributes is another aspect to consider. Depending on the infrastructure of IT functions, IT deployment may influence various attributes at all levels of aggregation. For example, the effect of a distance monitoring app deployed for a patient group in a hospital influences the information processing demands of an operational unit, whereas the effect of ERP software deployed organisation wide reaches the strategic level. However, the changes in attributes from different aggregation levels arise from different mechanisms, thereby demanding separate analyses. For example, attributes such as mortality rate and revenue per admission are more likely an aggregated effect of the multiple ongoing processes of a hospital when compared with attributes such as access to patient records and time to make decisions in surgical procedures. Consequently, the mechanism that explains the relationship between a particular type of IT and a highly aggregated performance attribute consists of more mediating and moderating factors than the relationship between the IT and a less aggregated performance attribute. Therefore, we discourage the application of the same relational model for performance attributes from different managerial levels to avoid ambiguity. Hence, we propose the following:

Proposition 3B: *Studies separately assessing the relation between IT deployment and performance attributes from different managerial levels will better explain the relationship.*

In Table 8, we present the IT functionalities and relevant performance attributes for future studies. The performance attributes found from the current literature review have been sorted into three focus areas: patient-, practitioner- and organisation-related outcomes. Depending on the IT and empirical setting of a study, different performance attributes can be chosen from the below table. Our research framework (Figure 4) suggests that the link between IT functionalities and healthcare performance depends on the changes in service operation (Proposition 2) and the context of the study (Proposition 4). Therefore, instead of connecting each functionality with certain performance attributes, we provide a pool of attributes pertinent to healthcare IT deployment.

Table 8 The pool of IT functionalities and performance attributes for future studies

Functionalities of healthcare technology	*Relevant attributes to assess outcomes*
• Assists the practitioners to detect, measure and treat patients' conditions • Real-time transmission of audio-visual and numerical data between practitioner and patients • Receives, stores, analyses, visualises and shares data among healthcare personnel and patients	*Patient-related outcome* Satisfaction, quality of care, mortality, continuity of care, patient safety, reliability, duration of hospital stays *Practitioner-related outcome* Quality of decision, time to make decision, ease of use (of IT), work content, working hour *Organisation-related outcome* Cost, waiting time, readmission rate, facility utilisation, personnel expense, net patient revenue, error in medication, service time

5.4 Considering the context of deployment

We propose that the link between IT deployment, affected service operations and healthcare performance can best be explained when the context of deployment is taken into consideration. Context implies the antecedent conditions of IT deployment, including both external features, such as economy and political stability, and internal features, such as the structure of the organisation and nature of the stakeholders and employees (Denyer et al., 2008; Pettigrew, 1987). Studies that consider context can provide practitioners with information about specific instances in which IT deployment improves (or does not improve) performance, thereby enhancing the external validity of the studies (Wacker, 1998). Hence, we propose the following:

Proposition 4: *Studies considering the context of IT deployment will better explain the relationship between IT deployment and healthcare performance.*

To summarise, the framework and propositions present a logic for framing the research problem and research design. If these propositions are followed in designing future studies, it is more likely that a coherent body of knowledge will develop over time, which can then provide readership with better conceptual understanding and guide practitioners to better predict and control the relation between IT deployment and healthcare performance. Consequently, the framework does not place any constraints on the choice of methodology for the studies. Both analytical and empirical studies that use statistical, mathematical or qualitative data can be designed using the framework. More than guiding the methodology, this framework encourages reshaping the research questions and providing propositions for doing so. However, we emphasise the importance of using multiple methodologies to develop a holistic understanding of the scope of IT deployment in improving healthcare performance (Boyer and Swink, 2008; Wacker, 1998), whereas the literature has a strong inclination towards empirical statistical methodology (Table 2). Along with Ketokivi and Choi (2014) and Voss et al. (2002), we call for more empirical case research in this domain because studies in this area have a high potential in theory extension and building.

6 Conclusion

The rapid advancement of technology employment in healthcare creates an increasing need for managerial knowledge that is scientifically rigorous and practically applicable. Multiple research disciplines have a significant role to play in creating this pragmatic knowledge. The current paper has shown how OM can contribute to this burgeoning field of healthcare technology management. We urge the research community to consider operations when studying the relation between IT deployment and healthcare performance. Our findings suggest that the OM literature within the domain of IT deployment in healthcare tends to measure performance without considering the changes in related healthcare operations. We argue that studies that analyse these changes in relation to IT functionalities, rational performance attributes and contextual factors can generate pragmatic knowledge. Thus, the present study contributes by devising a guideline for future research to advance knowledge on technology management in healthcare. Next, it also demonstrates how as an applied discipline, OM can increase its relevance within the domain of healthcare technology management.

Moreover, we anticipate that once studies begin to identify the relevant mechanisms underlying IT deployment and performance, the extension of existing theories and emergence of new theories will become more frequent, enriching the field of technology management. Current studies are apt when it comes to making predictions in the form of hypotheses that set out to measure variables, whereas theory development requires causal logic in the form of propositions that involve concepts (Whetten, 1989). Although existing studies answer the questions of *what* – and partly *how* – our framework can help answer the question of *why*, which is a fundamental aspect of theory (Meredith, 1998; Sutton and Staw, 1995; Wacker, 1998).

The current study is not without its limitations that can be addressed in future studies. The present study takes a systematic literature review approach towards assessing the status quo of ongoing research in technology management in healthcare. However, the literature can also be assessed using a bibliometric technique, which primarily provides a quantitative analysis of the literature. It will be valuable to conduct a bibliometric analysis of similar groups of the literature and compare the findings with those in the current paper. Finally, although we have used a broad range of keywords for searching relevant papers, changing the keywords and conditions may provide a marginally different set of papers to review. Therefore, conducting a literature review on a regular basis would lead to a more extensive view of the literature than what the current one can provide.

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Paper II

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RESEARCH Open Access

Impact of distance monitoring service in managing healthcare demand: a case study through the lens of cocreation

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Abstract

Background: There is a consensus among healthcare providers, academics, and policy-makers that spiraling demand and diminishing resources are threatening the sustainability of the current healthcare system. Different telemedicine services are seen as potential solutions to the current challenges in healthcare. This paper aims to identify how distance monitoring services rendered for patients with chronic conditions can affect the escalating demand for healthcare. First, we identify how distance monitoring service changes the care delivery process using the lens of service cocreation. Next, we analyze how these changes can impact healthcare demand using the literature on demand and capacity management.

Method: In this qualitative study, we explore a distance monitoring service in a primary healthcare setting in Norway. We collected primary data from nurses and general physicians using the semi-structured interview technique. We used secondary patient data collected from a study conducted to evaluate the distance monitoring project. The deductive content analysis method was used to analyze the data.

Result: This study shows that the application of distance monitoring services changes the care delivery process by creating new activities, new channels for interaction, and new roles for patients, general physicians, and nurses. We define patients' roles as proactive providers of health information, general physicians' roles as patient selectors, and nurses' roles as technical coordinators, data workers, and empathetic listeners. Thus, the co-creation aspect of the service becomes more prominent demonstrating potential for better management of healthcare demand. However, these changes also render the management of demand and resources more complex. To reduce the complexities, we propose three mechanisms: foreseeing and managing new roles, developing capabilities, and adopting a system-wide perspective.

Conclusion: The main contribution of the paper is that it demonstrates that, although distance monitoring services have the potential to have a positive impact on healthcare demand management, in the absence of adequate managerial mechanisms, they can also adversely affect healthcare demand management. This study provides a means for practitioners to reflect upon and refine the decisions that they make regarding telemedicine deployment and resource planning for delivering care.

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Keywords: Telemedicine, Distance monitoring, Co-creation, Demand, Resource, Management

Introduction

Background

There is a consensus among healthcare providers, academics, and policy-makers that spiraling demand and diminishing resources are threatening the sustainability of the current healthcare system [1, 2]. The rise in chronic ailments, multi-morbidities, and the aging population have increased healthcare demand, and the existing resources fall short of meeting these demands. The global burden of chronic disease is enormous, and it is currently one of the top ten causes of death worldwide [3]. Illnesses such as chronic obstructive pulmonary disease (COPD) and heart failure (HF) increase hospital admissions and the number of visits to general physicians, exerting additional pressure on healthcare resources and reducing the quality of care [4, 5]. These chronic diseases are also recognized as among the main causes of comorbidity [6] that increase the demand for healthcare even more. Telemedicine – the group of IT that facilitates the diagnosis, treatment, and monitoring of patients when distance separates the healthcare professional and the patient [7] – is seen as a potential solution for the current challenges in healthcare [8]. In general, the expectation from telemedicine implementation is that it would make the healthcare system more resource efficient [9]. Distance monitoring is one such aspect of telemedicine that is also considered to be instrumental in achieving good quality of care, particularly for chronic illnesses, such as COPD, diabetes, HF, depression, and cancers [10–12].

Several existing studies have investigated how distance monitoring service affects clinical efficacy and patient safety, which are essential to deciding whether this service is suitable for patients and to minimize the harm that might be caused by it [13, 14]. However, to implement distance monitoring service on a large scale and adopt it as a routine service, it is crucial to understand its effect on resource utilization [9, 15]. The way in which a new technology alters the existing workflow was found to be one of the main factors predicting its implementation success [16]. Therefore, it is essential to determine the changes in the care delivery process triggered by distance monitoring services. Furthermore, as previously mentioned, the global healthcare system is facing resource constraints. Hence, a telemedicine service that is not resource efficient will be much more difficult to implement and sustain, even if its clinical efficacy is well proven. Nevertheless, whether the application of distance monitoring can reduce the current discrepancies between demand and capacity in healthcare services is largely unknown [17].

Additionally, chronic ailments and multimorbidity make dynamic and diverse demands of care provision [18]. Therefore, a thorough analysis of how these demands can be managed is greatly needed [19]. Although poor management of healthcare demand and capacity has adverse effects—such as poor patient flow, reduced patient safety, communication failure, dissatisfied patients and healthcare professionals, and lost revenue—very few empirical studies have explained how the disparity between demand and capacity in healthcare can be improved [20–23].

Therefore, this paper aims to explore how distance monitoring services can affect demand and capacity management in healthcare. The objective of the paper is twofold, to identify: (1) how distance monitoring services change the care delivery process; and (2) how these changes can potentially improve the management of demand and capacity in healthcare. The guiding research questions (RQs) of the paper are as follows.

1. How do distance monitoring services change the care delivery process?
2. How do these changes in the care delivery process affect demand management in healthcare?

To answer these questions, we conducted a qualitative study of a distance monitoring service in Norway. We use co-creation of care as a theoretical lens and empirical data from a case study to answer the first RQ. The second RQ is answered through a conceptual analysis of the findings from the case study in relation to the demand and capacity management literature. The main contribution of the paper is that it demonstrates that, although distance monitoring can have a positive impact on healthcare demand management, in the absence of adequate managerial mechanisms, it can also adversely affect healthcare demand. We identify the circumstances under which distance monitoring services enable and limit the management of demand and resources in healthcare and propose enabling managerial mechanisms. This study has useful implications for both research and practice, as explained later. The remainder of the paper is structured as follows. First, we briefly discuss care co-creation and demand and capacity management strategies in healthcare leading up to the research framework; next, we explain the methodology of the study and elaborate on the case; the findings of the study are then presented,

followed by the implications of the findings for research and practice; and finally, we present concluding remarks, including the opportunities for future research.

Care co-creation

Co-creation is a much researched area in services including healthcare. This section does not provide an exhaustive review of this vast literature (e.g., [24–31]) but rather explains how this concept is used in this study. In the literature, the co-creation of service has been analyzed from two different perspectives: one proposes that service is always co-created with the customer, in our case, patients [26, 32, 33], and the other proposes that co-creation is an optional collaborative act in the customer-provider interface [34]. In summary, co-creation is about outlining and creating value through multiple repetitive collaborative processes between providers and consumers that include value proposition, resource integration, and learning processes [9]. In this study, co-creation is seen as an inherent aspect of healthcare service since patients' participation is essential for care creation. However, we also posit that the degree of patients' participation and collaboration between them and care providers vary from service to service. Moreover, the co-creation aspect of healthcare service can also be impacted by any change made to the service delivery process, for example, using telemedicine to provide care.

Therefore, to explore the care co-creation process of the distance monitoring service, we adopt McColl-Kennedy et al.'s (2012) dimensions of co-creation: activities, interactions, and roles [35]. Activities imply performing actions to co-create. Interactions imply engagement with others to co-create. Roles are the structures that imply individuals' representation in the co-creation process. The central argument behind these three dimensions is that the representational practices in service affect how individuals interact with each other, in turn influencing individuals' activities and consequently changing actors' roles, and the process repeats itself whenever there is an occasion for change [35]. In this study, we applied the dimensions of cocreation as an enabling theory to explain the phenomenon of interest, i.e., the changes in a care delivery process [36, 37]. Using these dimensions, we explore how the application of distance monitoring changes the activities and interactions and the roles of the actors in the care creation process. We apply this framework to the service triad of patients, nurses, and general physicians (GPs) – who are the main actors of the distance monitoring service, as explained in a later section. Compared to a dyadic relationship, for example, patient-nurse or patient-GP, the service triad provides a richer context for understanding the interactions, contributions, and nature of the actors involved [38, 39].

Demand and capacity management strategies in healthcare

The concepts of demand and capacity are more difficult to grasp, measure, and manage in the service context, including healthcare compared with that of physical goods [40]. Balancing demand and resources in healthcare is complex because services are: (1) perishable and cannot be inventoried and transported, leading to the simultaneous generation of demand and consumption of resources; (2) intangible and difficult to specify in terms of quantity and quality; and (3) characterized by a high degree of producer–consumer interaction [41–43]. In this paper, we analyze how, on a strategic level, the application of distance monitoring services can impact the management of demand and capacity. Therefore, we synthesize different demand and capacity strategies found in the service literature. We do not limit our analysis to the healthcare literature since distance monitoring can trigger a strategy that has yet not been used in healthcare services.

Demand management strategies are aimed at one or several of the following goals: (1) increase or decrease demand, (2) change the timing of the demand, and (3) rechannel demand to other resources [41, 44–46]. Focusing on different client segments for different demand periods is a demand strategy [47, 48], for example, dividing patients for walk-in visits and scheduled appointments [46] or into online and in-person visits [49]. Informing and educating customers constitute another demand management strategy that focuses on informing customers about peak and slack demand periods so they can make informed decisions about when to seek service [50, 51]. The referral system, i.e., patients requiring a referral from GPs to access specialized healthcare, is also a demand management strategy in which a high threshold is created to reduce the demand in hospitals [52].

Capacity management strategies aim to acquire and allocate resources to minimize waiting time and idle capacity while meeting demand [23, 53, 54]. In a service context, capacity is the maximum amount of output that is available in a given period with a predefined level of resources, i.e., workforce, equipment, and facilities [55]. Capacity management strategies include a flexible and multiskilled workforce, subcontracting facilities and equipment, and increasing client participation [23, 43, 47, 56, 57]. A flexible and multiskilled workforce adds more options in staff scheduling and allocation, and employees can easily shift from task to task as required [46]. Such as workforce includes the recruiting of temporary and on-call staff and awarding of overtime payments [58]. Subcontracting facilities and equipment indicates sharing capacity with other organizations, for example, using the same pathological laboratory by different clinics [41].

Examples of increasing consumer participation include restaurant buffet services and airport self-check-in [47, 50].

Research framework

Figure 1 exhibits the research framework for the study. The framework is built on the three dimensions of care creation and the demand and capacity management strategies. As the figure implies, we first identify the changes in the care delivery process triggered by distance monitoring service in terms of the activities, interactions, and roles of the patient, GP, and nurse, who are the main actors in the care delivery process. Then, we analyze how these changes at the operational level are aligned with demand and capacity management strategies to understand how distance monitoring services can contribute to improving the management of healthcare demand. A good fit between operational and strategic levels is crucial for any service to be implemented and sustained [59]. Nevertheless, technology-enabled services are often criticized for missing this fit, falling short in fulfilling the objective(s) and ending up as abandoned services [60, 61]. Therefore, we focus on the fit between the operational changes in the care delivery process and demand-capacity management strategies to argue how distance monitoring services can impact healthcare demand management. The methodology used to conduct the study is described in the next section.

Methodology

A case study is a suitable approach to understand the complexities of a certain phenomenon in relation to the context of the phenomenon [62]. To explore and understand telemedicine services in depth, this paper chooses a case study as its research strategy, in which the unit of analysis is the care delivery process in the service triad of patients, GPs, and nurses. Starting as a trial project in 2016 by the Norwegian government, distance monitoring services are now available in six municipalities that use the same telemedicine technology to support elderly patients with chronic diseases, such as chronic obstructive pulmonary disease, diabetes, and cancer [63]. As part of a project planned and governed by the central health authority, these municipalities follow the same service configuration. Initially, four municipalities agreed to contribute to our study. However, due to the COVID-19 pandemic, two could not participate since their limited human resources had to focus on the pandemic. Therefore, we use data collected from two municipalities to typify the distance monitoring service in this paper.

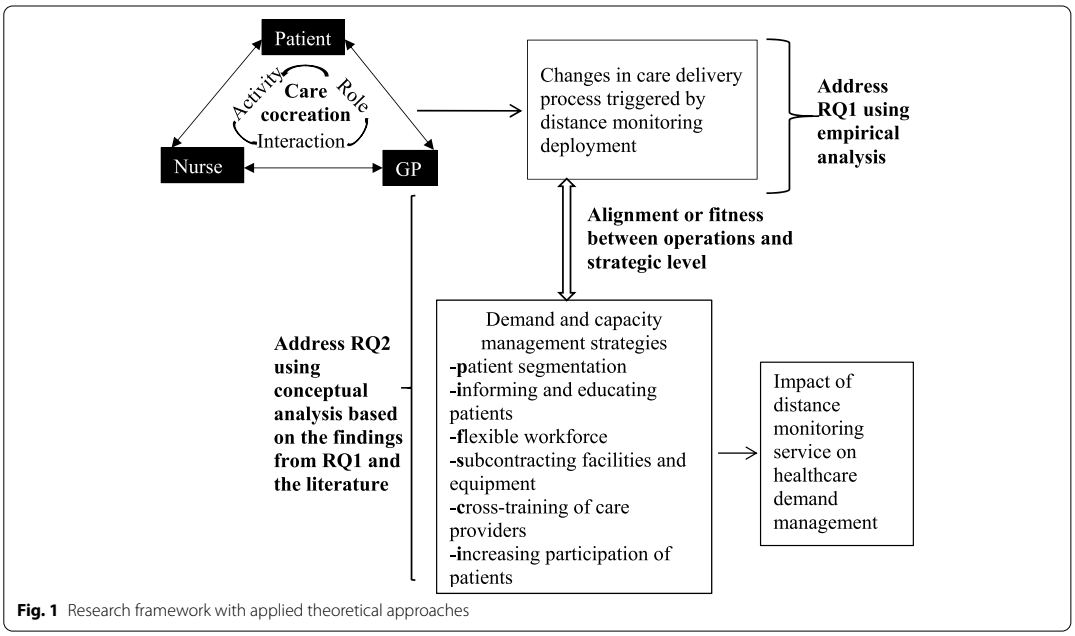

Fig. 1 Research framework with applied theoretical approaches

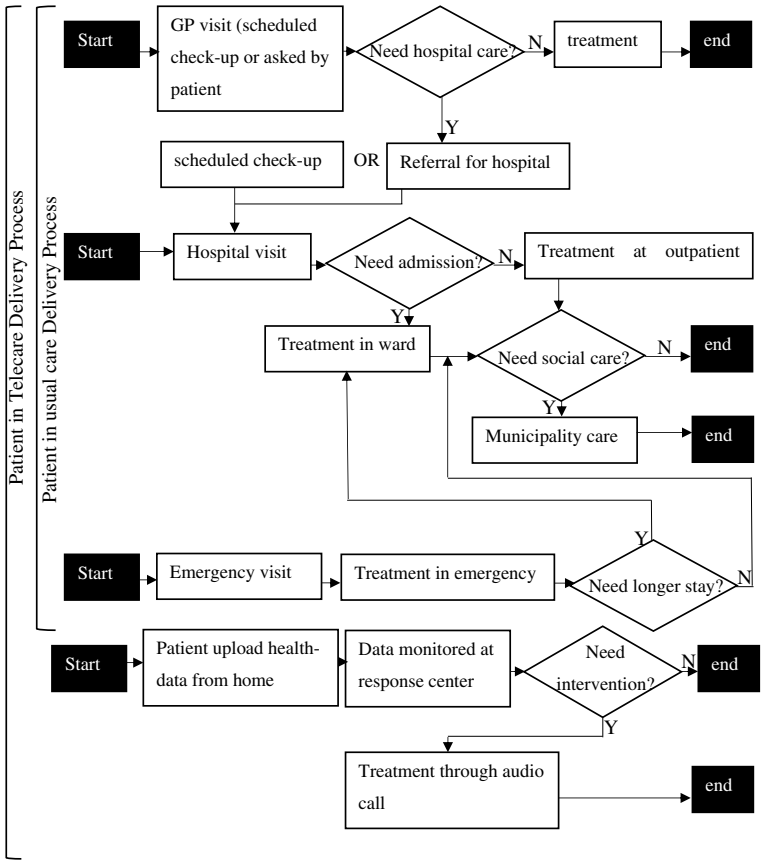

Fig. 2 Telecare and traditional care delivery process

Telecare and traditional care

In Norway, healthcare is fundamentally a public service. It has two parts: (1) primary care, consisting of GPs and municipality care; and (2) specialized care, consisting of hospitals providing diagnosis-specific services. Residents in Norway are assigned to GPs, who are the gatekeepers to specialized care—i.e., they refer 16 to hospitals if needed. Municipalities focus on keeping residents functional and healthy for as long as possible to minimize demands on home care and nursing homes. Thus, traditional care service in Norway consists of GPs, specialized hospitals, emergency care by hospitals and municipalities, and social and homecare by the municipality.

The main objectives of the distance monitoring service (hereinafter, telecare) are to: (1) provide patients with better care and opportunities to control their illnesses better; and (2) reduce resource utilization across primary and specialized healthcare [64]. It is noteworthy that patients enrolled in telecare have equal access to their GPs and hospitals as patients who are not enrolled in telecare but receive traditional care only. Traditional care and telecare services contain three and four types of care episodes, respectively (Fig. 2), i.e. series of healthcare-related events that a patient undergoes [65].

Ethical consideration

This study was approved by the Norwegian Centre for Research Data (NSD), and the reference number of the application is 800636. The committee assessed the application and decided that "the processing of personal data in this project will comply with data protection legislation, presupposing that it is carried out in accordance with the information given in the Notification Form and attachments, dated 08.10.2019. Everything is in place

for the processing to begin." We also sought permission (reference no. 58059) from the regional committee for medical and health research ethics (REK) to interview patients. However, the committee assessed that the project falls outside the scope of the health research act (ACT 2008–06-20 no. 44) and therefore could be conducted without REK's approval. Following the NSD guidelines, written consent was obtained for each interview, and the data were anonymized and stored on the researcher server of the university at which the project was conducted.

Data collection and analysis

We conducted the exploration of the literature, data collection, and analysis in parallel and iteratively from September 2019 to January 2021. This study uses qualitative data collected from multiple sources using multiple methods to identify whether these data corroborate each other and to build a coherent narrative for the case. This triangulation of data strengthens the findings and increases the study's quality [62, 66]. A brief description of data collection follows.

1. Non-participatory workshop observation

To enhance contextual insight into telecare services, the first author attended a workshop as a non-participatory observer [67] in the initial phase of the study (December 2019). This workshop, at which 12 GPs and nine nurses from all six municipalities shared their telecare experiences, was arranged by the Norwegian health ministry. This workshop helped us to understand the configuration of the telecare service followed by all of the municipalities and allowed us to contact these municipalities for in-depth data collection.

2. Documents and archives

We read and analyzed several project reports, which provided specific and precise information about telecare, helping us to understand its initiation and the evolution of the project. While we read many documents and newspaper articles, six telecare evaluation reports published from 2018 to 2021 were thoroughly read.

3. Semi-structured interviews

We developed an interview protocol [62] after a preliminary review of the literature and participation in the telecare service workshop. The interview protocol comprised different sets of questions for different respondents, i.e., nurses, management, GPs, the app developer, and patients. The aim was to gather in-depth information to build a comprehensive narrative capturing the changes in the care delivery process and their effects on resource utilization. To recruit the respondents, an invitation letter was sent to the management of the municipality care services, and one manager from each municipality became our main point of contact (POC). With the help of the POC, we sent invitation letters to all groups of respondents. The invitation letter provided an overview of the study project, including its objectives and context and the time required from the respondents. We did not provide the interview questions beforehand since we followed a semi-structured interview technique [68]. The inclusion criterion for participating in the study was that the respondent needed to have at least 3 months of experience with the distance monitoring service. We did not consider any demographic characteristics, such as age or gender, as criteria for recruiting respondents since the focus was to collect information about the care delivery process as a comprehensive system. To determine the number of respondents for all groups except app developer, we relied on data saturation – the stage of data collection in which information received from the respondents becomes repetitive and the likelihood of obtaining new information becomes negligible [69]. As Table 1 shows, we interviewed only one respondent in relation to app development since the other personnel directly connected to this project no longer worked for this software company. However, the app developer interviewed by us is the project leader and had comprehensive knowledge about the development and deployment of the distance monitoring app. Moreover, the information collected from this respondent was corroborated by information collected from other sources. The duration of the interviews varied from 45 to 75 min. After transcribing the interviews verbatim, we conducted follow-up interviews with four respondents (1 nurse, 1 GP, and 2 managers) to clarify issues raised in previous discussions. All of the respondents were asked on the consent form whether they would like to receive and check the transcript or audio of the interview, and none have made such requests. Table 1 provides an overview of the interview respondents. Only one patient was interviewed before the pandemic started; due to restrictions, face-to-face meetings became infeasible, and digital meetings with patients were not approved ethically. Therefore, we used secondary data on the patients' feedback.

4. Secondary patient data

Despite having little to no control over data quality, using secondary data sources is a valid and even recommended research strategy, especially when primary data are unavailable [68]. Since the patient's voice is significant

Table 1 Overview of interview respondents

Respondents		Number of interviewees	Number of interviews
Nurses	Monitoring nurse	8	8
	Coordinating nurse	2	3
Management	Manager in the municipality care	4	6
	Human resource manager in response center	2	2
General physicians (GP)		3	4
Distance monitoring app developer		1	1
Patients		1	1
Total		21	25

for understanding the co-creation of care, we decided to use secondary data when patient interviews were no longer an option. To include patients' voices, we used official reports that are accessible to the public and are considered a valid source of secondary data (e.g., [70]). We used the assessment report of the project [71], consisting of 15 patients' interviews and one group discussion. The report aimed to understand patients' perception of telecare, in agreement with our aim of interviewing the patients. We undertook several precautions to ensure the quality of the data: (1) to minimize researchers' bias, direct patient feedback was used, instead of the report's analysis; (2) the data were collected in late 2019 and early 2020, overlapping with our data collection period; and (3) one of the authors of the report, a nurse, was interviewed to understand the context of the data collection and the types of questions asked.

Following a systematic combining approach [72], we started analyzing the data in the early phase of data collection. Initially, collected data were used to edit the interview protocol and identify literature that supported or opposed our findings [66]. From emerging data and an iterative literature review, we developed a guiding research framework (Fig. 1). Eventually, a case diary was developed, including transcriptions of all interviews, workshop notes, and information extracted from project reports. It should be mentioned that, whereas data collected from management and app developer: (1) enriched our understanding of the context, which is essential for case studies [62]; and (2) were used for data triangulation [66]; the data collected from nurses, patients, and GPs were further analyzed.

We applied the content analysis method [73] to analyze the data. Between deductive and inductive content analyses, we chose deductive analysis since we had developed the research framework and identified the constructs for analyzing the data. Therefore, the dimensions of co-creation—activities, interactions, and roles—were used to categorize the data. To extract relevant information for these dimensions, we used the following predefined criteria: (1) tasks; (2) actors; (3) the link between different tasks and the actors; and (4) the different tools used, e.g., telemedicine app and different EHRs. The next task was to arrange these activities and interactions chronologically to visualize the care co-creation process. Using a visual mapping technique [74], the complex process of care co-creation was outlined using pen and paper, a schematic version of which is exhibited in Fig. 2. The different actors' roles became visible through this exercise.

We continuously collaborated, both externally with the respondents and internally among co-authors throughout the analysis process. The analysis of the data was conducted in close collaboration with all of the authors. The first author transcribed the interviews and developed the case diary, which was thoroughly reviewed by the other two authors. During this process, the authors identified some gaps in the narration that were closed by conducting four follow-up interviews as mentioned earlier. Moreover, several statements made by the first author were questioned by the other two, and upon further discussion and analysis of the interview transcriptions, the statements were adjusted. We followed a similar process during the grouping and plotting of the data in our framework. Moreover, the findings were presented to one of the GPs and one management representative to identify whether our analyses were based on any wrong assumptions.

Results

Changes in the care delivery process

This section answers the first RQ: How does distance monitoring service change the care delivery process? Using co-creation as the theoretical lens, we describe how the application of a distance monitoring service changes the activities, interactions, and roles of the main actors in the care delivery process, i.e., patients, GPs, and nurses, and finally, we summarize the findings at the end of the section.

Patients

Patients in telecare are required to report their health condition regularly to the response center using a distance monitoring application (app) on a mobile phone or tablet. First, patients measured various health parameters, such as blood pressure and oxygen levels, using different equipment. Patients found this exercise helpful.

> *"It is good to do and see my own health measures, and thus I don't have to wonder about how my health is." - Patient 3*
> *"You can measure your blood pressure if you are feeling strange, and that's great!" - Patient 4*

Moreover, the app asks questions about factors such as the color of the cough and breathing condition. To answer these questions, the patients must systematically think about and assess their health.

> *"I believe I can feel my health better. I observe the symptoms (worsening signs) much earlier." - Patient 1*

The app itself conducts a quick data assessment and provides the patient with a simple result regarding their health status in terms of the green, yellow, or red zone, ranging from good to bad. Furthermore, patients can write messages in the app to communicate with the response center, as one nurse explained.

> *"His health assessment is always on the yellow side, but he sends us a message saying, 'I am okay; don't call me." – Nurse 6*

Real-time data sharing and interaction with nurses can cause the patient to feel safer at home, as one patient explained, "The fact that someone is watching out for you makes this service very helpful." Patients, however, can find it inconvenient to perform these activities regularly, especially when they are not feeling sick.

> *"I don't feel like thinking about my disease every day…" – Patient 2*

"You may not want to think about your disease on the days you are fine." – Patient 3.

While patients' perceptions about telecare service vary, one important aspect that has emerged is that, for this service to function, patients' participation in the care co-creation process must be increased. Measuring and providing health data are new activities added to patients in telecare services, and the distance monitoring app has become the new channel of interaction between patients and nurses. Thus, patients play an increasingly important role in the care delivery process. We define this new patient role as a proactive supplier of health data.

General physicians (GPs)

In the telecare service, GPs are responsible not only for holding consultations and providing referrals but also for recruiting patients for this service. The recruitment process consists of the following activities: (1) identifying suitable patients for telecare depending on patients' health status and ability to use the app; (2) introducing and offering telecare services to suitable patients; (3) providing coordinating nurses with lists of patients willing to join; and (4) devising treatment guidelines for individual patients included in telecare. This individual treatment plan is the basis for the treatment-related decisions made by monitoring nurses in the response center. Thus, GPs in the telecare service interact with these nurses, either in person or via telephone and e-messages.

GPs believe that the patient recruitment process is one of the most important aspects of telecare service and is directly connected to patient safety.

> *"[The] most important thing is how we include patients and which ones are to be excluded [from telecare]." – GP 1*
> *"You do not want to include someone who will not benefit from such a service option" – GP 2*

Furthermore, compared with doctors from specialized care or nurses, GPs have the most comprehensive knowledge about patients' health and lifestyles, making them more eligible to recruit patients:

> *"We do not deal with one disease or diagnosis but the whole person." – GP 3*
> *"For some patients, I even know their grandparents, so I have a better overview of the patients to see if they fit [the telecare service]." – GP 2*

Thus, we identify GPs taking a new role in recruiting suitable patients for telecare, and we define this role as a patient selector.

Nurses

The nurses can be divided into monitoring nurses performing activities in the response center and coordinating nurses performing activities coordinating with GPs, patients, and monitoring nurses.

The coordinating nurse makes the first contact with a patient after recruitment. Next, they receive the treatment plan from the respective GP and set the app accordingly. Then, they meet the patient face to face to train him or her on using the app and other equipment. In addition to coordinating the recruitment process, the coordinating nurse also makes monthly contact with those patients not providing health data as planned. This interaction aims to establish why the patient is not cooperating and

whether they can start using the app again. Last, the coordinating nurse resolves technical issues that arise at the patients' end regarding the app and equipment. We identify this role as a technical coordinator since the coordinating nurse is responsible for technical coordination, in addition to care coordination. The following quotes from coordinating nurses exemplify this role.

> *"I go through the [patient] log and call those patients who are not using the app one by one. Sometimes they have some technical problems, such as passwords being erased for system updates or a lost internet connection in the tab. Then, I help to solve those." – coordinating nurse 2*
> *"It is easier to fix the technical issues, but it takes a lot of my time to find the patients and call them one by one to know why they are not using [the app]." – coordinating nurse 1*

The monitoring nurses work in the response center and interact with patients and occasionally with GPs. First, app alerts inform them about patients' activities. If the data are in the yellow or red zone or the patient has asked to be contacted, the monitoring nurse calls the patient. During these calls, the nurse can change the medicine or doses of an ongoing medicine according to the treatment plan. These decisions depend on how nurses interpret the data and compare them with previous data and the treatment plan. Thus, instead of seeing the patient and examining him or her, these nurses navigate through different IT systems, making sense of data and making decisions accordingly:

"To work in [a] response center, one needs to love technology." – Monitoring nurse 8.

> *"It's different here [in the response center] than my work at the hospital. Now I work a lot with [IT] systems." – Monitoring nurse 3*
> *"We have to be very good at handling data now and have to switch fast from one system to the other." – Monitoring nurse 7*

We define this role as data worker. Next, our data reveal that the interactions with patients also soothe them, alleviating their stress or anxiety:

> *"Talking to [the patient] over the phone can calm them down. Sometimes they just want to hear from you that everything is fine." – Monitoring nurse 2*
> *"A lot of these patients are old and live most of the day by themselves. Just calling them and asking, 'How are you doing today?' makes a difference for them." – Monitoring nurse 4*
> *"They become relaxed and end up sharing lots of things, like what to buy for their son's birthday, or 'My pet has not eaten today.'" – Monitoring nurse 5*

We define this role as empathetic listener because it is quite different to interact with patients by telephone to understand their needs and communicate accordingly to calm them and cause them to feel better compared with having a face-to-face conversation. As one nurse put it:

> *"One must develop an ear [to understand patients' needs]." – Monitoring nurse 6*

Table 2 Changes in the care delivery process in telecare service

Actors	Activities	Interactions	Identified novel roles
Patient	Uses the equipment and app to measure and record health data Answers questions in the app Reviews the results of health assessment using the app	Meets the coordinating nurse to learn how to use the app and equipment Sends messages to nurses via the app Talks to nurses via telephone	**Proactive supplier**
General physician	Identifies and recruits suitable patients for telecare Makes first contact between the coordinating nurse and patient Develops treatment plans for individual patients	Has face-to-face interactions with patients and coordinating nurses during the recruitment process Is contacted by monitoring nurses via e-message	**Patient selector**
Municipality nurse	Coordinates the recruitment process and the patient training Tracks patients not conforming to the telecare treatment Resolves technical issues Monitors data coming from the patients in real time Interprets data to make treatment decisions based on the individual treatment plan	Calls the patients to make changes in treatment and pacify him or her Sends e-messages to GPs, either to provide information or to receive further information about particular patients Ensures that treatment plans are standard documents of communication between nurses and GPs	**Technical coordinator** **Data worker empathetic listener**

Table 2 provides a summary of the identified activities and interactions in the telecare delivery process and the new roles that emerged.

Effect of telecare service on healthcare demand management

This section answers the second research question: How do these changes in the care delivery process affect demand management in healthcare? We analyze how the changes in the care delivery process are aligned with different demand and capacity management strategies. In this conceptual analysis, we consider the new roles of patients, nurses, and GPs as the units of change in the care delivery process because these roles simultaneously represent the changes in activities and interactions. We consider each actor and assess the extent to which the changing role(s) are aligned with demand and capacity management strategies and can potentially improve the management of healthcare demand.

Patient as a proactive supplier: increasing client participation

Increased patient participation is a necessary condition for telecare service since only the health data and the queries uploaded in the app by the patients can initiate the service. The effectiveness of this service also depends upon on how timely a basis these data are sent. If the patients wait until they are severely sick, then a visit to the emergency or the GP is inevitable, defying the objective of telecare service. If the patients are both skilled and willing to contribute to data measuring and sharing, it is reasonable to expect reduced demand for GPs, hospital visits, and emergency admissions. Thus, ideally, increasing patients' participation can indeed improve resource utilization, concurring with the literature [43, 46]. However, when the patients are unwilling or not sufficiently skilled to measure and register their health data regularly, the nurses cannot support the patients. The complexity of this aspect is at least twofold, as emerged in our case. First, not all patients are equally interested in helping to manage their disease, nor are they all equally skilled, as the coordinating nurses explained:

> *"Sometimes they forget the password or give the wrong password too many times, so the app stops working." – coordinating nurse 1*

> *"There is a tendency to stop using the app when a person is stable for some time." – coordinating nurse 2.*

In the current telecare service, the only mechanism focusing on managing patients' involvement is that of the coordinating nurses, by which they contact the patients who are not conforming with their treatment plan. This mechanism does not ensure patients' future participation, and it could become infeasible to check on individual patients manually if the number of such patients increases significantly. The high level of dependency that telecare service has on its patients, thus adds complexities in maintaining service quality. If the patients do not cooperate in supplying the data through the app, the response center cannot provide them with the timely, required support. Consequently, patients could end up visiting GPs or hospitals at the same rate as patients from traditional care, jeopardizing the effectiveness of telecare services.

GPs' role as patient selectors: segmenting and rechanneling clients

GPs' role as patient selectors implies that telecare services are suitable only for patients with certain abilities and willingness and, most importantly, comparatively stable health conditions. The underlying objective of this patient segmentation is to reduce the demand for traditional care and rechannel them to the telecare service. However, for the segmentation and rechanneling strategy to function effectively, it must be ensured that telecare patients use fewer resources than patients in traditional service. Telecare service is, however, an additional channel, indicating that the patients enrolled for this service have equal access to GPs and hospitals as the patients from the traditional service. Therefore, if patients' need for GPs and hospitals is not met or reduced by telecare, they will end up utilizing resources from both telecare and traditional services, aggravating demand escalation. One recent financial evaluation of the telecare project reported such a negative gain in resource utilization [63]. While sufficient empirical evidence is unavailable to explain this increased use of resources, the aforementioned scenario can conceptually explain the reason.

Thus, segmenting and rechanneling clients to telecare does not constitute an infallible strategy to reduce healthcare demand. GPs' role as patient selectors could be an effective mechanism to ensure that telecare service is offered only to those patients who will benefit from it so much that their visits to GPs and hospitals will eventually be minimized. However, the absence of guidelines for patient selection in the current service configuration threatens the effectiveness of GPs' role as patient selectors.

Multiple roles of monitoring nurses: flexible and multiskilled workforce

A flexible and multiskilled workforce is often mentioned as an effective strategy for managing demand for services [22]. The emergence of multiple new roles for nurses in

telecare services indicates the need for nurses to become flexible and be simultaneously skilled in several dimensions. The response center provides a lower threshold for patients in making real-time contact with healthcare personnel. By performing a variety of tasks, including providing technical support, interpreting data, pacifying patients, and altering treatment, nurses also add flexibility to the range of services offered through telecare. From the patient's perspective, it is much quicker to reach and receive relevant support from nurses compared with the time necessary to consult with traditional care service. However, in the current telecare service, the training of the nurses for these novel roles is not quite visible. According to HR managers and nurses, the nurses receive on-the-job training in their initial days of employment. This training focuses on using the IT systems and app and is conducted by one or two on-duty senior nurses. No education or training on providing distant care or data interpretation is provided.

Overall, the analysis indicates that the changes in the care delivery process enable opportunities to implement several demand and capacity management strategies. However, in the current telecare service, these strategies are neither consciously devised nor managed and are devoid of proper mechanisms that could make them effective in managing healthcare demand. Consequently, the current telecare provision might not make a positive contribution to addressing the issues of spiraling demand and diminishing resources in the current healthcare system. More importantly, in the absence of proper strategic implementation, the changes in telecare services could even complicate resource distribution and lead to increased use of resources. Table 3 provides an overview of which demand and capacity management strategies are aligned with identified changes in the care delivery process and the implications for telecare service.

Discussion

Key findings

The findings of the study are twofold. First, it identifies the changes in the care delivery process of a distance monitoring service using the lens of service co-creation and the service triad. Several new activities (Table 2) are added to each of the actors, and patients' participation

Table 3 Identified demand and capacity management strategies in the telecare service

Novel roles in the telecare service triad	Potential demand and capacity management strategies	Implications for the telecare service
Patients as proactive suppliers	Increasing clients' participation	**Current status:** Add complexity to telecare services since the quality of patients' contributions cannot be forecasted and controlled **Potential:** If the patients are adequately skilled and comply with care plans, the demand for GPs and specialized care would be reduced. Such patients would become more active in the care cocreation process. Consequently, they would have a better understanding of and greater control over their health status
GPs as patient selectors	Rechanneling demand	**Current status:** To ensure meaningful contributions by patients in the care cocreation process, selecting patients with the right skills and adequate willingness is essential. Otherwise, patients could end up using resources in both telecare and traditional care channels, with the possibility of increased resource utilization **Potential:** A structured guideline based on empirical evidence of clinical efficacy could ensure that the patients chosen for telecare are able to exploit the services provided by nurses and thus will require fewer GP and hospital visits
	Client segmentation	**Current status:** Individual GPs have their own way of selecting patients for the telecare service, which does not ensure effective use of telecare **Potential:** Can be a useful mechanism for: (1) categorizing the patients for telecare and traditional services based on a standardized guideline; (2) choosing the right patients for telecare so that they have a reduced need for traditional care
Nurses as technical coordinators, data workers, and empathetic listeners	Multiskilled and flexible workforce	**Current status:** In addition to tending to patients, nurses also become more active in the cocreation process in telecare. Multiple roles played by nurses render telecare responsive and easily accessible. However, the need for new competencies related to technology and distant care is not recognized; thus, adequate training is lacking, which can lead to reduced quality of care **Potential:** Nurses' roles are essential in rendering the treatment and support of telecare effective. However, (1) formalization and systematic evaluation of the competencies needed and (2) corresponding training are essential to make these roles, and thereby the telecare service, effective

in creating care becomes more prominent than that with the traditional service. The distance monitoring app becomes the new channel of interaction between patients and nurses, whereas the interactions between GPs and nurses become more frequent. Several new roles emerge for patients, GPs, and nurses, which we define as proactive suppliers of health data, patient selectors, technical coordinators, data workers, and empathetic listeners, respectively.

Second, this study indicates that distance monitoring service, on the operational level, creates several opportunities for better management of healthcare demand since the changes in the care delivery process fit with four demand-capacity management strategies found in the literature, namely increasing patients' participation, segmenting and rechanneling the patients, and flexible and multiskilled nurses. This finding is in line with the findings of studies focusing on preventive and self-management care for patients with chronic ailments [5, 75]. However, on the strategic level, these strategies have yet to be devised and implemented. We demonstrate (current statuses in Table 3) that, in the absence of adequate support from the strategic level, the changes identified in the care delivery process have limited and, to an extent, adverse effects on demand management. Our analysis additionally indicates that the care delivery process becomes increasingly dependent on patients and requires new skills for nurses and GPs. These changes indicate that telecare provides provisions for co-creating care by involving different actors, most importantly the patient, in the care delivery process. These changes simultaneously add complexities to the care delivery process, which can hamper the quality of care and resource efficiency, if not addressed actively. Therefore, these changes must be recognized and managed to exploit the potential of distance monitoring services in improving healthcare demand management.

Supporting mechanisms to manage the changes

The findings suggest that, despite the potential of distance monitoring services, the fundamental challenge in managing healthcare demand remains the lack of adequate managerial provisions at the strategic level. To address this issue, we propose three supporting mechanisms: foreseeing and managing new roles, aligning capabilities with the potential of telemedicine, and adopting a system-wide perspective. We have updated the research framework (Fig. 3) with the findings and the mechanisms to present how healthcare demand can be better managed using distance monitoring services. In what follows, we elaborate on these mechanisms.

The emerging new roles should be acknowledged and formalized in telecare services. Although the literature has studied patients' roles in care co-creation to an extent (e.g., [35]), we identify that deployment of distance monitoring significantly changes healthcare personnel's roles as well. Management must recognize these changes in roles and related activities so that the actors can play these new roles with minimal challenges. Patients' increased involvement in their treatment has been portrayed as empowering and positive development in the healthcare literature [76, 77]. An underlying assumption of this proposition could be that all patients are equally able and willing to take charge of their health using telemedicine. However, our study indicates otherwise. Patients were not always eager to use the app and upload their health data regularly, and GPs had to rigorously select patients who are suitable for the distance monitoring service. Informing and educating patients, which constitute a demand management strategy found in the service literature [50, 51], can be an important enabler under this circumstance. Letting the patients know about this service and what it requires from them could help them to make informed decisions about whether they want to receive this service or not. Moreover, the

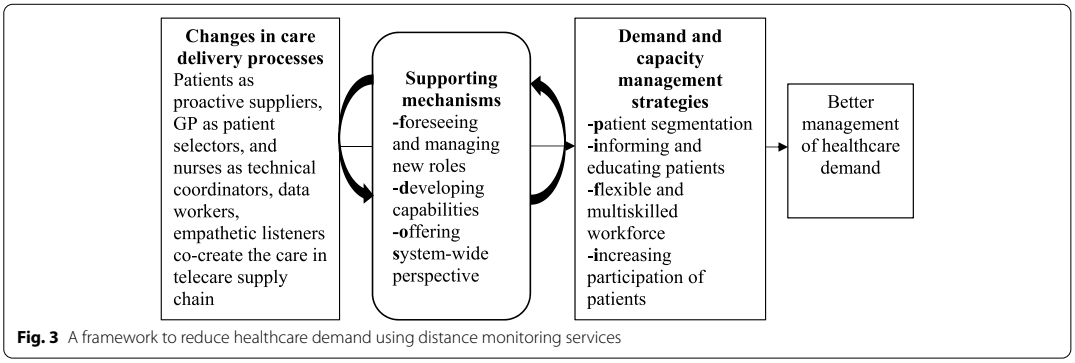

Fig. 3 A framework to reduce healthcare demand using distance monitoring services

recognition of new roles played by GPs and nurses is the first necessary step in assessing whether and to what extent new skills are required to play these roles effectively. For example, nurses in distance monitoring services require a certain level of IT competence as technical coordinators and data workers [78]. Nurses, as empathetic listeners, communicate and provide care through the app instead of through an in-person interaction, requiring additional social and communication skills [79].

The current service configuration has lacked deliberate effort in developing such capabilities across the care delivery process. It was predicted that the competence required for digital health services will take time and grow incrementally [80]. The current on-the-job training, therefore, might not be sufficient for developing the capabilities required by these nurses. Concerning GPs' roles as patient selectors, although professional knowledge and experience with patients provide initial support [81], a lack of guidelines for patient selection could lead to inconsistent service offerings and thus poor service quality [82, 83]. We posit that the data generated by telecare services could provide a scientific basis for creating these guidelines. This dataset includes patients' longitudinal health data and also reveal their app use patterns. This rich dataset could be used to create simulation models to identify the profiles of suitable patients and the demand trends of such patients [84].

Finally, we argue that a system-wide perspective, instead of a provider or user perspective, is essential to implement distance monitoring services or any other telemedicine. Different organizations within the primary and specialized healthcare system are involved in the care delivery process, especially for patients with chronic and multimorbid conditions. Therefore, it is important to consider the system-wide impact of telemedicine implementation. Our study indicates that the distance monitoring service adds new activities for GPs and nurses and results in creating a response center as a new care delivery point. From the municipality perspective, the service increases the resource requirement. However, when seen from a system-wide perspective, the service can reduce the demand for specialized care and emergency care, in the end positively impacting healthcare demand management. A system-wide perspective also implies connecting operational and strategic activities. In this study, the identified changes are at the operational level of the service and are not planned but rather emerge as the consequences of telemedicine deployment. We argue that support mechanisms from the strategic level of service are required to manage these changes so that potential risks can be minimized and the effectiveness of telemedicine can be maximized.

Research implications

Our research has valuable implications for both academia and practice. This study addresses the need for empirical research on healthcare demand management, which has been raised by many [20, 22, 85] and met by very few (e.g., [86, 87]). Questions have been raised about whether flexible and easier access to care, as offered by telecare services, and curbing demand for care can coexist [86]. This study offers an explanatory answer to these calls and questions by showing that services can better manage the healthcare demand while providing easy access to care. However, the deployment of technology might not be sufficient to achieve this balance. The implementation of the technology must be supported by these mechanisms to manage the changes triggered by the new technology.

Although studies focusing on digital health are rife, this study is among the few [81, 82] focusing on the effects of digitalization on collaboration and communication among different actors. Using the concept of co-creation and service triad, this study identifies that such services change the communication channel from face-to-face interaction to indirect, but more frequent, app-based interaction. Moreover, the need for collaboration among the main actors is increased for the service to function efficiently. The comprehensive identification of these changes also enables us to analyze the impact of such services on healthcare demand management. Both the research community and practitioners expect that telemedicine has a positive impact on demand and resource management in healthcare [49]. However, the current literature does not provide sufficient information on whether and how services such as distance monitoring can affect this issue. Our paper is one of the first to analyze the relationship between distance monitoring services and healthcare demand. In so doing, several aspects come into view that have not been discussed in the literature to date. The findings indicate that telemedicine can positively contribute to demand management, but it also adds complexities to the service, for example, making the service more dependent on patients' proactive participation, requiring new skills, and adding new activities. These complexities, if not recognized and managed, can add uncertainties to the service and increase the use of resources, leading to reduced quality of care. The merit of such analysis is the comprehensive understanding of the managerial aspects of telemedicine that have been less investigated in the extant literature but are essential for better service configuration and improved care.

For practitioners and policy-makers, this study provides important insights related to new roles and competencies. The identified new roles and managerial mechanisms provide a means for managers to reflect on their planning and decision-making regarding

telemedicine implementation. Often, healthcare organizations, as in our case, introduce telemedicine services hoping that they can reduce resource consumption. This study draws attention to telemedicine being able to facilitate certain strategies but managerial actions in designing telecare services remaining pivotal in addressing the escalating demand with limited resources. Finally, we draw policy-makers' and practitioners' attention to the need for new competencies and education and training to develop these competencies, which are essential for large-scale implementation, and use of telemedicine as a regular service as opposed to pilot projects or interventions.

Limitations and direction for future research

Our study has a few limitations. Applying the co-creation and service triad concept was appropriate to comprehensively identify the changes in the care delivery process. However, it limits the use of management's voice in our analysis since managers are not explicitly active in the care delivery process. Therefore, we used the data from management (Table 1) for triangulation purposes to corroborate the main data material. This paper focuses on telemedicine in a public healthcare setting. While the design enables in-depth analysis and better reflection, we believe that similar studies are needed in different contexts with similar and different IT provisions. For example, if a healthcare system decides that, instead of creating a response center, GPs will manage the distance monitoring app, how will this change affect co-creation processes and strategies, such as workforce flexibility and resource utilization? The findings of multiple studies could then be compared, and patterns of demand management could be cross-matched to devise precise theories on the relationship between telemedicine and healthcare demand management. Next, studies analyzing quantitative data on demand and resource utilization could advance the findings of this study by adding new empirical insights. Finally, our findings indicate that distance monitoring services provide new provisions for co-creating care by increasing patients' active participation, which could be further investigated and analyzed in relation to patients' quality of life in future studies.

Conclusion

Meeting the healthcare demand with available resources is a global challenge. With the increasing size of the elderly population, chronic ailments, and multimorbidity, the disparity between demand and resources seems to deteriorate even more with time. Therefore, it is important to explore the merit of telemedicine in solving this pressing issue. Given that technology implementation in healthcare is a complex phenomenon, it is not sufficient to know only whether telemedicine can contribute to managing the escalating healthcare demand; we must also know how we can do so. Therefore, this paper first demonstrates the complex changes in the care delivery process triggered by the implementation of the distance monitoring service. Next, we explain the potential of the service to improve demand management by analyzing the fit between the service operations of the care delivery process and demand-capacity strategies from the literature. Our analyses also suggest that, in the absence of strategic support, the potential for telecare services to improve demand management cannot be exploited, and the service could have unintended consequences, such as added uncertainty and an increase in resource consumption. Therefore, we propose a set of managerial mechanisms for telemedicine services to bridge the gap between operations and strategic levels to improve healthcare demand management. This article contributes to the eHealth literature by identifying the specific potentials of distance monitoring services in improving demand management. It does so by demonstrating how the operational changes in terms of activities, interaction and roles pave the way for demand-capacity strategies to be implemented. The next contribution is to underscore the essential need for managerial mechanisms to connect the strategic level and operational level of eHealth services and specify those mechanisms. These contributions have serious implications for the large-scale implementation and sustainable use of telemedicine since the need for managerial readiness of implementing telemedicine is often overshadowed by the promises of the technical abilities of telemedicine.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12913-022-08164-2.

Additional file 1. Interview guide for municipality nurses.

Additional file 2. List of documents used as data sources as mentioned under the documents and archives section in the manuscript.

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Authors' contributions

AE, HCD, and LDB designed the study and data collection plan. AE collected, transcribed, and anonymized the data and provided a preliminary narration of the case. AE, HCD, and LDB conducted the data analysis and interpreted the data. AE drafted the manuscript, and HCD and LDB contributed equally to refining it. All of the authors read and approved the final version and agreed to submit it.

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Availability of data and materials
The data collected and analyzed during the current study are not publicly available to maintain the confidentiality of the respondents, as well as the organizations and their processes, but they are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate
This study was approved by the Norwegian Centre for Research Data (NSD), and the reference number of the application is 800636. The committee assessed the application and decided that "the processing of personal data in this project will comply with data protection legislation, presupposing that it is carried out in accordance with the information given in the Notification Form and attachments, dated 08.10.2019. Everything is in place for the processing to begin." We also sought permission (reference no. 58059) from the regional committee for medical and health research ethics (REK) to interview patients. However, the committee assessed that the project falls outside the scope of the health research act (ACT 2008–06-20 no. 44) and therefore could be conducted without REK's approval. Following the NSD guidelines, written consent was obtained for each interview, and the data were anonymized and stored on the researcher server of the university at which the project was conducted.

Consent for publication
Written consent for publication was obtained from each of the respondents at the beginning of each interview. The consent to interview and the consent to publish were requested on the same form, on which we explained how the data would be handled, anonymized, and stored, and we informed respondents that these data would be published in the form of scientific articles and would be provided via open access to readers.

Competing interests
The authors declare that they have no competing interests.

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Publisher's Note

Paper III

Original Paper

Individuals' Perceptions as a Substitute for Guidelines and Evidence: Interview Study Among Clinicians on How They Choose Between In-Person and Remote Consultation

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Abstract

Background: Video consultation (VC) is increasingly seen as a cost-effective way of providing outpatient care in the face of dwindling resources and growing demand for health care worldwide. Therefore, the sustainable implementation of VC is a phenomenon of interest to medical practitioners, researchers, and citizens alike. Studies are often criticized for not being sufficiently robust because the research settings are mostly small-scale pilot projects and are unable to reflect long-term implementation. The COVID-19 pandemic has compelled clinicians worldwide to conduct remote consultation, creating a favorable context to study large-scale remote consultation implementation.

Objective: The aim of this study was to thoroughly investigate how clinicians reason their choice of different consultation modes in the routine of consultation and what the underlying reasons are for their choices. We posited that a deeper understanding of clinicians' perceptions of remote consultation is essential to deduce whether and how remote consultation will be adopted on a large scale and sustained as a regular service.

Methods: A qualitative approach was taken, in which the unit of analysis was clinicians in one of the largest university hospitals in Norway. In total, 29 interviews were conducted and transcribed, which were used as the primary data source. Using the performative model of routine as the theoretical framework, data were analyzed using deductive content analysis.

Results: Clinicians have mixed opinions on the merits and demerits of VC and its position between in-person and telephone consultation. Totally, 6 different planning criteria were identified, and individual clinicians used different combinations of these criteria when choosing a mode of consultation. The ideals that clinicians hold for conducting consultation can be divided into three aspects: clinical, interpersonal, and managerial. VC engenders a new ideal and endangers the existing ideals. VC causes minor changes in the tasks the clinicians perform during a consultation; thus, these changes do not play a significant role in their choice of consultation. Clinicians could not identify any changes in the outcome of consultation as a result of incorporating a remote mode of consultation.

Conclusions: Clinicians feel that there is a lack of scientific evidence on the long-term effect of remote consultation on clinical efficacy and interpersonal and managerial aspects, which are crucial for consultation service. The absence of sufficient scientific evidence and a clear understanding of the merits and demerits of VC and standard practices and shared norms among clinicians regarding the use of video for consultation both create a void in the consultation practice. This void leads clinicians to use their personal judgments and preferences to justify their choices regarding the consultation mode. Thus, diverse opinions emerge, including some paradoxical ones, resulting in an uncertain future for sustainable large-scale implementation, which can reduce the quality of consultation service.

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KEYWORDS

video consultation; work routine; outpatient care; telemedicine; clinician; professional work

Introduction

Background

Video consultation (VC) is increasingly seen as a cost-effective way of providing outpatient care in the face of dwindling resources and growing demand for health care worldwide [1,2]. Several pilot studies have reported VC to be beneficial while providing health care access to patients in rural areas with insufficient care providers [3,4], thus making the consultation time-efficient [5], reducing the need for travel for patients [6,7], and providing the ability to add care providers from different locations and family members as needed to provide coordinated care [4]. Therefore, the sustainable implementation and adoption of VC is a phenomenon of interest to medical practitioners, academic researchers, and citizens alike. Studies on VC have taken several trajectories, such as measuring efficacy, diagnosis-specific outcomes, and safety. However, these studies are often criticized for not being sufficiently robust because the research settings are often small-scale pilot projects or interventions and, therefore, are unable to reflect long-term implementation [2,8]. To address this gap, we focused on a hospital where VC is no longer a trial project but is gradually becoming a regular service. We aimed to understand how, in their regular work routine, clinicians choose a particular mode of consultation when three alternative modes—in person, video, and telephone—are available to conduct a consultation. Clinicians are the ultimate decision makers in adopting or abandoning technology in hospitals [9]; therefore, they are the focus of this study. The pandemic has compelled clinicians worldwide to use remote consultations through telephone and video. Therefore, clinicians have gained substantial experience in conducting remote consultations. Thus, the pandemic has created a favorable context to study how clinicians choose the consultation mode. In contrast, as pandemic restrictions are being lifted, it is crucial to investigate how clinicians are making sense of the situation and how this may impact remote consultation implementation. Henceforth, we have used the term *remote consultation* to imply both video and telephone consultation and the abbreviations *PC*, *VC*, and *TC* to imply in-person, video, and telephone consultation, respectively.

Previous Studies

Although there is a lack of in-depth studies considering the intricacies of remote consultation implementation, recent studies have focused on the process of implementation. The nonadoption, abandonment, scale-up, spread, and sustainability framework aims to assist and evaluate the success of technology-enabled health care programs through pragmatic questions focusing on seven domains: condition or illness, technology, value proposition, adopter system, organizations, wider (institutional and societal) context, and interaction and mutual adaptation among all these domains over time [10]. An extension of this framework—the planning and evaluating remote consultation services method—has been developed for VC. This framework evaluates the following domains: reason for consulting, patient, clinical relationship, home and family, technologies, staff, health care organization, and wider system [11]. These frameworks offer a comprehensive method for planning and evaluating implementation. However, the mechanisms that drive or limit the implementation process are not the focus of these frameworks.

Nonetheless, studies on how VCs have expanded during the pandemic has discussed these mechanisms, positing that the reasons for successful expansion include the national-level groundwork conducted before the pandemic, a strong strategic vision, a well-resourced quality improvement model, dependable technology, and multiple opportunities for staff to try the video option [8]. However, these results are only from the pandemic period. As this is a special situation and does not reflect normal conditions, it does not shed light on the future of VC when the pandemic no longer limits citizens' movements. A prepandemic study by Greenhalgh et al [12] investigated the real-world implementation of VCs and concluded that (1) although clinicians consider VC to be safe, effective, and convenient for some patients in certain situations, those situations are rare compared with the overall number of outpatient consultations and (2) it is challenging to embed VC into the routine practice of consultation when clinicians are hesitant to change.

A recent literature review indicated that empirical studies focusing on VC implementation did not identify the distinct processes essential for achieving large-scale adoption of VC [13]. We argue that how clinicians choose different modes of consultation is an essential process in the long-term adoption of VC. Clinicians are empowered with expert knowledge that is inaccessible to people outside the clinical profession; thus, clinicians decide both the definition of the goals (eg, what is quality of care) and the means to reach the goals (eg, how the quality of care can be attained) [14]. On the one hand, clinicians have codified knowledge and standard practices based on scientific evidence. However, on the other hand, they have shared values and norms that are seemingly flexible, yet uniformly shared and strongly held [15]. Therefore, clinicians play a crucial role in the implementation of any technology in hospitals, and their role may even be more significant for VC adoption because, mostly, a consultation is a one-to-one service between the clinician and patient. We posit that a deeper understanding of clinicians' perceptions of remote consultation is essential to deduce whether and how VC will be adopted on a large scale and sustained as a regular service. Hence, this study focused on how clinicians decide on the mode of consultation in their regular work routines. We used the performative model of routine as the theoretical framework, as explained in the following section.

Theoretical Framework: Performative Model of Routines

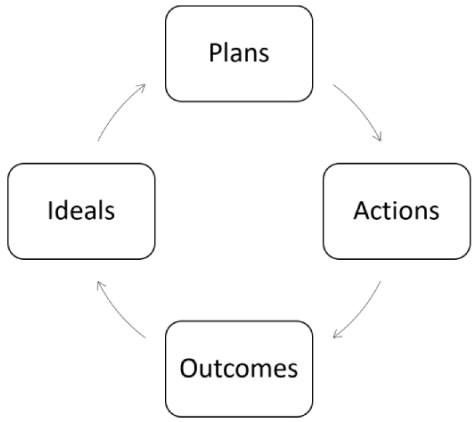
Studying information technology (IT) implementation from a professional's routine perspective can provide a better understanding of the long-term applications of IT [16]. The tasks within an organization are accomplished through temporal

structures known as routines [17], standard operating procedures [18], and habits [19]. "An organizational routine is not a single pattern but, rather, a set of possible patterns—enabled and constrained by a variety of organizational, social, physical and cognitive structures—from which organizational members enact particular performances" [20]. Routines work as both stabilizing force and apparatus to evolve with changing environmental demands in an organization [16]. We used the performative model of routine [21] to identify how the implementation of VC impacts the routine of consultation. Figure 1 shows how the equilibrium of the state of routines can change and follow a new pattern in organizations; this model has been used in different studies as a theoretical lens for studying human-technology interaction [22], along with how people make sense of the changing organizational goals [23].

According to the performative model of routine, routines are not fixed actions performed by the people in an organization; rather, they are dynamic patterns stemming from ongoing exchanges between ideals, plans, actions, and outcomes. Ideals represent normative influences including values, goals, missions, and expectations. Plans are thoughts and intentions that cause the actions. Plans and actions generate the outcome. The outcomes are then compared with the ideals to set the next course of plans and actions. None of these 4 aspects are immune to change. Even ideals can be altered if the generated outcomes—whether intended or unintended—reveal new possibilities. The people in an organization change the routine when they see that the outcomes of the ongoing routines are either falling short of the ideals or showing the possibility of new ideals. When the outcomes fall short of the existing ideals, the actors strive to change their plans and actions to attain the ideals. When the outcomes show the possibilities of new ideals, the actors expand their plans and actions to fulfill the new ideals. We used this model to frame how clinicians make sense of the implementation and continuation of the large-scale application of VC, along with TC and PC, in hospitals.

This study aimed to thoroughly investigate how clinicians reason their choice of different consultation modes, namely, PC, TC, and VC. The performative model of routine provided us with a systematic structure to analyze clinicians' choices regarding different consultation modes. On the basis of the findings, this paper also explained the underlying reasons for the clinicians' choice. The following was the guiding research question: How do clinicians choose the consultation type from among PCs, VCs, and TCs?

Figure 1. Performative model of routine [21].



Methods

Overview

A qualitative approach was taken, in which the unit of analysis was the clinicians in one of the largest university hospitals in Norway, which is anonymized as the Pioneer Hospital in this paper. We purposefully chose this hospital because it provides a rich ground to investigate our research question. As the name suggests, the hospital is a pioneer in promoting and deploying cutting-edge digital tools to provide and manage health care services in the region. An active research and development center works closely with the hospital management to maintain a progressive approach regarding the use of technologies in health care, and the hospital has a substantial financial budget for the innovation and implementation of new technologies. As the Pioneer Hospital has a long tradition of innovating and designing IT-enabled services, it can be presumed that there are fewer managerial and organizational challenges to the implementation of VC when compared with a hospital that has little or no experience with the implementation of new technology. A hospital that seemingly has few managerial and economic challenges in implementing VC can provide us with the opportunity to look beyond the financial and organizational challenges mentioned in previous studies [12] and focus on how clinicians choose between different modes of consultation. In the following sections, we have discussed the context of the study and explained the data collection and analysis process.

Research Setting

Amid resource constraints and an increasing demand for health care, the health authority in Norway has decided to implement VC as an alternative to PC in hospitals countrywide. The goals of implementing VC are to (1) reduce the cost incurred from a

patient traveling to and from the hospital for PC and (2) reduce the travel-induced stress and other activities that a patient may need to consider (eg, taking leave from work and managing childcare) [24]. Following the mandate of the health authority, the Pioneer Hospital started to prepare to implement VC and decided to use Skype for Business (Microsoft Corporation). This was a strategic decision because this software had been in use in the Pioneer Hospital previously for long-distance meetings. Therefore, the people working in the hospital, including clinicians, were familiar with the technology and video calling options. After buying adequate accessories (eg, headphones and video cameras), the hospital started to implement VC in 2019. The clinicians were not involved in planning or designing the VC implementation. They were also not forced to adopt VC. Initially, the advisers reached 3 of the department heads to ask their clinicians to conduct VC as a pilot project. The plan for the pilot project was made by the advisers and department heads, who were also clinicians and conducted consultations. The clinicians were given the freedom to decide whether and when VC is suitable. No particular goal (eg, minimum number of VCs) or time frame was given for the project. Before the introduction of VC, the hospital had two modes of consultation: PC and TC. However, TC was used as an impromptu way of contacting the patient, specifically when a quick call to the patient seemed to be more practical than waiting for weeks—or even months—for a scheduled consultation. The hospital was not paid for these TCs, and no records of the number of TCs made by the outpatient clinics were maintained.

At the beginning of 2020, the hospital asked all the departments to start conducting VCs. Similar to the pilot project, the clinicians were given the freedom to decide on the mode of consultation. However, this time, an annual goal was set for the departments, not for the individual clinician. As mentioned by both advisers and clinicians, there was no penalty or consequence for not being able to meet the goal. Currently, a plan is made to provide additional budgets to the departments that meet the goal in the future. At the beginning of VC implementation, the health authority changed the reimbursement plan for how the clinics were paid (by the government) for the consultations. According to the new plan, VC and TC were reimbursed with 75% and 67% of that received for PC, respectively. Despite the request to use VC and this change in the reimbursement plan, the clinicians were sluggish in using VCs until the COVID-19 pandemic hit the country and a nationwide lockdown was announced in March 2020. The restraint on movement stopped the patients from visiting the clinics for consultations, and the hospital was only allowed to admit patients with emergency issues. Therefore, clinicians were compelled to conduct VCs more frequently than before the lockdown. As the lockdown continued, the health authority revised the reimbursement plan again, this time, providing equal pay for all modes of consultation. This plan has remained active so far, irrespective of the changes in the strictness of the lockdown. Textbox 1 provides an overview of the time line of VC implementation in the hospital since 2019.

Textbox 1. Implementation of video consultation (VC) at the Pioneer Hospital (2019-2021).

2019

- Identified VC to be a solution (1) for reducing the cost of public health care service by reducing the need for patients to travel to hospital for consultations and (2) by reducing travel-induced stress and other activities for patients.
- Planned and arranged the necessary software and hardware for VC.
- Conducted pilot projects for VC.

2020 (before the pandemic and lockdown)

- Set a goal for the number of VCs for each department after discussion with the department heads.
- Started to receive incentives for telephone consultation and VC, at rates of 67% and 75% of an in-person consultation, respectively.

2020 (from the beginning of the pandemic and lockdown)

- Changed the incentive to be equal for all modes of consultation.
- Revised and scaled up the goals for VC.
- Total number of VCs increased from 200 (in 2019) to 2000.

Present (October 2021)

- Planned to give an additional budget to the departments that reach the annual target of VC by the end of the year.
- Planning to establish VC as a regular alternative to in-person consultation in standard patient pathways.
- Saved NOK 52,000,000 (US $5,362,318) in traveling costs.

Ethics Approval

This study was approved by the Norwegian Center for Research Data (NSD; reference number 800636). The committee assessed the application and decided that “the processing of personal data in this project will comply with data protection legislation, presupposing that it is carried out in accordance with the information given in the Notification Form and attachments,

dated 08.10.2019. Everything is in place for the processing to begin." We also sought permission (reference number 58059) from the Regional Committee for Medical and Health Research Ethics (REK) for interviewing patients. However, the committee assessed that the project falls outside the scope of the Health Research Act (ACT 2008-06-20 number 44); thus, it could be conducted without the REK's approval. Following the NSD guidelines, written consent was obtained for each interview, and data were anonymized and stored on the researcher's server at the university where the project was conducted.

Data Collection and Analysis

A semistructured interview technique was used to collect data. Following the checklist provided by the consolidated criteria for reporting qualitative research [25] and the case study protocol guidelines provided by Yin [26], we developed an interview guide (Multimedia Appendix 1). The guide includes three sets of questions to be asked to the clinicians, patients, and advisers, respectively. The interview guide aimed to include all questions that could capture the complexities and dynamic character of the clinicians' routines of consultation and VC implementation process. The questions were open ended, and the focus was to gather information on (1) the VC implementation process, (2) how the implementation of VC changes the consultation process, and (3) the perceptions of VC. To create a broad array of questions, we did not follow any particular framework at this stage, but instead, outlined the questions following different studies, including the performative model of routine [21], technology acceptance models [27,28], and structurational model of technology [29]. The interview guide was submitted to the hospital authority, NSD, and REK before data collection began. The questions were approved without changes. However, we added question number 8 for the clinicians after the first interview because that interview revealed that the duration of consultation may vary and that the documentation of patient records requires substantial amount of time.

We studied VC implementation in the Pioneer Hospital since the fall of 2019 and interviewed a group of clinicians (n=16), advisers of the research and development center responsible for facilitating VC implementation (n=7), and patients (n=16). We selected these 3 groups because they have the best knowledge of implementing, conducting, and receiving VC service, which is an essential criterion for selecting the sample [30]. All the advisers involved in VC implementation in the hospital were interviewed. To recruit clinicians and patients, we sent invitation letters to them, asking them to participate. The inclusion criterion was that they had experienced at least one mode of remote consultation, that is, TC or VC, at least once in the past 6 months. The hospital's communication channel was used to send invitation letters via email. To determine the number of clinicians and patients in the respective sample group, we relied on data saturation—the point of time when information from the informants becomes repetitive and no further information can be gained from further data collection [30]. Therefore, to recruit enough informants, the invitation letter was sent twice to clinicians and thrice to patients, leaving an interval of 2 months in between. The interviews were a mix of face-to-face and video calls, following the pandemic guidelines in the region.

The face-to-face interviews were audio-recorded, and video calls were video-recorded. Documents and nonparticipatory observation methods [31] were used to gather contextual information. A wide range of reports on the digitalization of the hospital, published between August 2019 and August 2021, was scrutinized. These reports can be divided into two categories: (1) public reports published by the government and (2) internal reports published by the hospital. The first group of reports provides the macrocontext of VC implementation, presenting how the government is planning and strategizing different digital health services, including VC [24,32,33]. The second group of reports provides the ongoing status of VC implementation in the hospital, including the numbers of PC, VC, and TC, along with the future goals for these consultation modes. To maintain confidentiality, these reports are not cited. Furthermore, the first author (AE) participated and took notes in a workshop in which clinicians shared presentations of their experience of using VC with the top management. Subsequently, the author gained access to those presentations.

In this study, the primary data source was interviews with clinicians, whereas the other interviews, documents, and observation notes were used for contextual understanding and data triangulation [34]. Data triangulation was performed to enhance the quality of the data used and strengthen the findings of the study [26]. We interviewed the clinicians twice: once in the middle of the pandemic (2020) and once when the pandemic-induced restrictions were lifted in Norway (2021). Of the 16 clinicians, 3 (19%) clinicians could not participate in the second round of interviews for different reasons, resulting in a total of 29 interviews. The first round of interviews lasted between 60 and 75 minutes, and the second round lasted approximately 45 minutes. All the interviews were recorded and transcribed. We contacted 19% (3/16) of the clinician-informants via email after the transcribing process to obtain some clarification on certain issues mentioned in the interview.

To keep data analysis transparent and easy to understand, we followed the criteria from the consolidated criteria for reporting qualitative research framework, which suggests reporting on the number and roles of data analysts and the derivation of themes and performing participant checking [25]. Initially, all the recordings of the interviews were transcribed verbatim by the first author (AE) to minimize interviewer bias. The interview transcripts were then read several times to gain familiarity with the content, and a comprehensive narration of the case was written and shared with the other 2 authors (HCD and LdB). A narrative strategy is often used in qualitative studies to organize data and increase contextual understanding [35]. The remaining data analysis can be divided into two parts: (1) mapping the VC implementation process and (2) mapping the clinicians' routines for conducting consultation services. To map the VC implementation process, we used a visual mapping strategy that is beneficial to arrange data from different sources sequentially and against the time line [35]. Therefore, we plotted the events that occurred regarding the implementation of VC. We plotted these events as narrated by our informants and as described in public and internal documents. We used pen and paper to map

the process. Textbox 1 presents a schematic version of the implementation process.

For the second part of data analysis, we used the deductive content analysis method, which "...aims to test existing categories, concepts, models, theories, or hypotheses...in a new context" [36]. The performative model of routine was applied as the theoretical framework to guide our analysis. The four aspects of the model (ie, ideals, plans, actions, and outcomes) were used to color-code the quotes in the clinician's interview, and then, those quotes were grouped under these 4 aspects in an Excel spreadsheet. This process was conducted separately for the first and second rounds of the interviews to assess whether their perceptions and routine have changed over time. During this process, the coauthors investigated different quotes obtained from the clinicians and discussed their meaning to ensure that the researchers' personal biases were minimized. Moreover, no change in routine or perception was identified between the two rounds of interview. The notes made from the documents and experience-sharing webinar were then cross-matched with the data content in the Excel sheet. Finally, the narrations of advisers and patients were thoroughly read and compared with the clinicians' data content to identify discrepancies among the clinicians, advisers, and patients. For example, we asked both clinicians and patients how they decided on the mode of their next consultation. Therefore, we compared the answers provided by patients with those provided by clinicians to identify any discrepancies. Similarly, we compared the advisers' responses to whether a guideline is provided to the clinicians on when to use which mode of consultation with the response of clinicians. Subsequently, our analysis was presented to the study participants in two meetings at the hospital and two digital meetings with the advisers and clinicians, to ensure that the researchers were not misinterpreting the data or misusing the quotes. The feedback received from these meetings was considered for further refinement by changing a few words in the findings, so that they were easier to understand.

Results

Overview

In this section, using the performative model of routine, we identified how the clinicians chose different modes of consultation. First, we have provided a list of ideals, plans, actions, and outcomes (Textbox 2), and then, we have explained and analyzed them with exemplar quotes.

Textbox 2. List of ideals, plans, actions, and outcomes in the routine of consultation, as described by the clinicians.

Ideals

- Right diagnosis.
- Right course of action for treatment (ie, laboratory test and medicine).
- Good communication and conversation with the patient.
- Making patients feel safe and comfortable about the diagnosis and the treatment.
- Reducing patients' stress or need to adjust the daily schedule for traveling to the hospital.

Plan

- Whether physical examination is needed in the next consultation.
- Whether telephone consultation (TC) is more efficient than video consultation (VC) for this consultation because it has low need for technical ability and the consultation room does not need to be equipped with microphone, speaker, and camera.
- Whether VC is more efficient because the patient can be seen to an extent.
- Where the patient lives.
- Whether the patient will be able to use the technology for VC and understand and respond to the instructions over a video call.
- Whether making a telephone call instead of a video call can add any benefit for the clinician, for example, by taking the call from home or after clinic hours.

Action

- Checking the patient's history and referral immediately before inviting the patient into the consultation room or a day before, depending on the time available to the clinician and complexity of the case.
- Bringing the patient into the room (for in-person consultation [PC]), calling the patient using a telephone (for TC), or logging in for the VC and admitting the patient from the web-based waiting room to the web-based consultation room.
- Troubleshooting technical issues both at the clinician's and patient's end. If the technical issue (most often at least one party cannot see or hear the other) persists, either calling the patient by phone immediately or rescheduling the consultation (for VC).
- Opening up the conversation and conducting clinical triage.
- Conducting a physical examination (only for PC).
- Taking notes on paper or computer.
- Prescribing medication and ordering tests.
- Discussing the time of the next consultation (this step is irregular).
- Filling the reimbursement form and giving it to the patient (for PC) or the health administrator at the end of the day (for VC and TC).
- Filling the details of the consultation in the patient's electronic health record.
- Submitting the completed form to the system.

Outcome

- Patients are diagnosed correctly and appropriate treatment is started.
- Laboratory tests are ordered to further investigate the patient's health status.
- The laboratory report is discussed with the patient, and suitable treatment is started.
- The effects of treatment are checked, and the course of future treatment is set.

Clinicians' Choice of Consultation Type: PC, VC, and TC

Ideals and Outcomes

Outcomes and ideals are closely related because ideals are the desired outcomes. Therefore, we have discussed these 2 aspects together. In the Pioneer Hospital, the clinicians did not feel the need for a change in consultation routine before VC was introduced. Therefore, VC was an agenda placed on clinicians from an external source (ie, the government), rather than a change initiative taken up internally by the clinicians. Among the five groups of ideals presented in Textbox 2, a new ideal is emerging because of the implementation of remote consultations. Previously, it was taken for granted that a patient must visit the clinician in person for consultations. However, with opportunities for remote consultation burgeoning, clinicians are becoming aware that making the consultation easily accessible to patients should also be a desired outcome. However, two different patterns in clinicians' opinions of how VC implementation is affecting the ideals have been identified:

(1) endangering the existing ideals of consultation and (2) creating new ideals. Regarding the first pattern, we identified that the aspects can be divided into two parts: clinical aspects, for example, assessing the symptoms and identifying the diagnoses, and interpersonal aspects, which are more subjective and include human interaction, communication, and the importance of small talk. Clinicians have shown certain reservations about VC, as it can reduce the ideal or expected quality of care if conducted regularly in place of PCs. This is illustrated by the following quote:

> *The fact that the video calls are brief and to the point may sound very positive, there is a negative aspect to that as well. We are actually, very dependent on knowing on who this person is, what kind of patient do we have in front of us, what is their societal context, who do they live with and what do they work with, how is their lifestyles and how would they present their symptoms, and how any disorder they might have that influences the daily life—so a lot of things around those we need to understand. So, if we have to depend on solely on screen for this kind of knowledge that would be limited and that's a type of quality loss. And that can be harmful in the long run.* [clinician 9, during the first round of interviews]

Regarding the interpersonal aspects of the consultation, the clinicians had diverse opinions. Some thought that VC can significantly reduce the quality of these aspects, thus affecting the quality of care:

> *I actually see a great value in that small talk part, and I feel it is important as a doctor to connect with your patient and it increases their will to use the medication that you prescribe, and it enhances the doctor-patient relation. That's very important for the patient to trust the doctor and I think that part of consults disappears a bit when we are doing it over the phone or video. I think that's why a lot of my patients have said that they look forward to coming here.* [clinician 11, during the first round of interviews]

Others agreed that these aspects are important for the treatment, at least to an extent, but felt that VC does not reduce the quality of these aspects:

> *I would say, they [small talk] contribute, they are kind of an ice breaker, but everybody there really understands why we are here. They are not really here to chat with me, they are there for the treatment. With VC, I manage to have that much chit chat.* [clinician 4, during the second round of interviews]

Although these opinions are primarily about whether and how VC can endanger the overall quality of care in the consultation service, another stream of thought focuses on whether and how VC can improve the quality of care. Some clinicians emphasized how VC makes the consultation service easily accessible to patients and their family members by reducing the need to travel to the hospital, thereby minimizing travel-induced stress and tiredness, as illustrated by the following explanation by a clinician:

> *We do not want the children to miss their school and parents to miss their job a lot. Because then disease becomes a big part of their daily life. So, making the treatment as less intrusive as possible is our goal, which can be attained using video consultation under specific circumstance[s].* [clinician 1, during the first round of interviews]

Thus, VC opens up the possibility for clinicians to minimize patients' travel-related challenges, which results in the emergence of a new ideal in the consultation service. These two patterns of ideals—potentially harming the care quality and potentially improving the care quality—create opposing effects on clinicians' decisions about VC. Those who perceive that the potential loss of care quality outweighs the reduction of travel-induced predicaments are more likely to prefer PC over VC when other aspects, which will be discussed later, remain the same. Similarly, those who perceive that the reduction of travel-induced predicaments outweighs the potential loss in care quality will prefer VC over PC. However, the clinicians did not identify any changes in the outcome of the consultation, positing that it was very early to detect whether VC will change the outcome of the consultation:

> *It will take time to see how really VC affects the consultation in the long run.* [clinician 2, during the second round of interviews]

The other aspects can be grouped as managerial ones that include dimensions such as waiting time and facility use. Some clinicians thought that the durations of TC and VC are shorter than that of PC. Thus, according to them, using VC and TC, where appropriate, can reduce a patient's waiting time:

> *Think about it. A person enters your room, hangs the overcoat, and settles down on the chair. By that time, she is quite relaxed and up for more like a conversation. So, we open up the conversation with how is the weather, how was the travel to the hospital, and then, we start talking about treatment, health, and so on. We don't do that on video or telephone consultation. So, they [TC and VC] take a shorter time.* [clinician 16, during the first round of interviews]

In contrast, some clinicians thought that the duration of the consultation is not dependent on the mode of consultation (ie, the duration does not vary depending on whether it is PC, VC, or TC):

> *Usually, I plan video consultation for 30 minutes, physical for 30 to 60 minutes. But you know, on a given day, telephone consultation can also take 60 minutes. So you cannot generalize. Sometimes, video consultation can take even longer [than physical]. Either the patient or I can have a technical problem, so it takes more time to connect with the patient and keep the talk going.* [clinician 12, during the first round of interviews]

Finally, the clinicians thought that VC can affect facility use in the hospital. The consultations conducted over the telephone and video do not need a traditional consultation room equipped for physical examination; thus, they can be conducted in either

the clinicians' private office or smaller rooms that are equipped for telephone and video calls without beds and other clinical apparatus:

> *In our outpatient clinic, we are at the border of the capacity, so if we are to continue to expand the way we have in the last 10 years with 5–7% the number of patients, it would not work. We have to do something. So to us, the prospect of increasing our activity with telephone and video is a necessity.* [clinician 1, during the second round of interviews]

However, this outcome cannot be realized until the number of VC and TC reaches a certain level:

> *But we need a certain volume in order to change the use of a room or to relieve ourselves from hiring rooms from the internal system for that. So, we have not saved anything as of today, it must be in the future.* [clinician 15, during the first round of interviews]

To summarize, the clinicians shared diverse thoughts on how VC and TC can affect the ideals and outcomes of the consultation. These opinions can be grouped into clinical, interpersonal, and managerial aspects. Depending on a clinician's perceptions of (1) how different modes of consultation affect each of these aspects and (2) how these aspects affect the overall quality of consultation service, the clinician will make plans for the consultations. In the following section, we have elaborated on how clinicians plan and conduct different consultations.

Plans and Actions

Textbox 2 lists 6 different planning criteria that clinicians use to choose the consultation mode. However, not all clinicians consider all these criteria, and their opinions about these criteria are varied. Some clinicians considered patients' living location as a criterion for choosing VC or TC, whereas others thought this can result in discrimination because patients living closer to the hospital would receive more PC than those living farther away. In this section, we analyzed how the clinicians reasoned for their planning criteria. Here, it is noteworthy that even amid the restrictions of the pandemic, the number of TC was much higher than that of VC, and it continues to be so. Clinicians who were used to TC before VC was introduced often thought that if a physical examination is not required in a consultation, the flexibility and ease that TC offers outweighs the benefit of seeing the patient's face, as can be seen from the following quote:

> *We feel that the telephone is sufficient; it works well. Everyone has a telephone, it is easy, everyone knows how to use it, and to start this video consultation, you need to collect email addresses from the patients beforehand, make a call appointment, you have to log on to the tech [the video platform], the patient has to log on to the tech–all that seems like new obstacles without gaining any clinical advantage for them.* [clinician 7, during the first round of interviews]

In contrast, some clinicians emphasized the importance of seeing patients, thus considering VC to be superior to TC:

> *To be honest it is very interesting to see patients in their own home, the background. Sometimes I feel like to go to their home and see how they live, if it is tidy or they living in the mess. This is very valuable for the doctors. When you see the patients on video or they come to you, you see a lot of that life that is missed in audio. Most importantly you need to see the face of the patients, this is very important. All that you miss in a telephone consultation.* [clinician 5, during the second round of interviews]

We identified some changes in the steps of consultation activities (Textbox 2) when a clinician conducts VC or TC instead of PC. The changes in actions were limited to making a video or telephone call instead of taking the patient into the consultation room, communicating with the patient through a device (ie, computer or telephone instead of direct communication), and occasional troubleshooting of technical issues. Although these activities are new to the routine of consultation, they are not unfamiliar to clinicians or something that clinicians need to learn or be trained for. The software used by clinicians to make video calls has been in use at the Pioneer Hospital for long-distance videoconferences for some time. This makes VC easier for clinicians. However, the clinicians sometimes faced technical difficulties in making video calls. An easy work-around for such instances was switching to telephone calls, and the clinicians did not report troubleshooting the issues after the consultation:

> *As long as I have made the consultation, talked to the patient, I do not go back on thinking why Skype did not work this time.* [clinician 4, during the first round of interviews]

Besides these changes in some of the steps of consultation activities, we did not identify any changes in terms of the role that clinicians have in the consultation. Textbox 3 provides an overview of how the clinicians navigated through these 4 aspects of the consultation routine in PC, VC, and TC.

Textbox 3. A summary of the routine of consultation incorporating in-person consultation (PC), video consultation (VC), and telephone consultation (TC).

Ideals

- The ideals that clinicians held for consultation can be divided into three aspects: clinical, interpersonal, and managerial, and all the three aspects affect the quality of care.
  - Clinical aspects include diagnoses and treatments.
  - Interpersonal aspects include human interaction, communication, trust, safety, and comfort.
  - Managerial aspects include waiting time and facility use.
- Introduction of VC prompts clinicians to consider (1) a new ideal of improving a patient's accessibility to the consultation service by reducing travel-induced stresses and time spent for the consultation and (2) whether VC can potentially reduce the quality of human interaction and communication and weaken the patient's experience regarding safety and level of comfort in consultation.

Plans

- Clinicians had mixed opinions on the potential merits and demerits of VC and its position between the two other modes of consultation (ie, TC and PC) that existed before the introduction of VC.
- Totally, 6 different planning criteria have been identified in Textbox 2, and the individual clinicians used a different combination of these criteria when choosing a mode of consultation.

Actions

- According to the clinicians, conducting VC does not require rigorous training and does not add to or omit any existing role. The minor changes in the actions in a consultation do not seem to play a significant role in clinicians' choice of consultation mode.

Outcomes

- The clinicians could not identify any changes in the outcome of consultation because of the introduction of VC. Cost reduction was an evident outcome of remote consultation in hospitals. Although clinicians were aware of the importance of cost efficiency to run the hospital, they did not consider this as a desired outcome of consultation service.

Discussion

Principal Findings

This study found that clinicians' choice of consultation mode depends on clinical, interpersonal, and managerial aspects and the changes identified in their daily consultation-related tasks are simple to manage. However, when they were faced with technical difficulties in conducting VC, they preferred to switch to TC instead of spending time in fixing the technical issue. Although the health authority and hospital management have emphasized the cost efficiency of VCs, the clinicians did not consider it to be a deciding factor for consultation mode. Before the introduction of VC in the hospital, the clinicians did not find it necessary to change the ongoing consultation service that included only PC and TC, and they could not identify any change in the outcome of the service after the introduction of VC. We identified that the clinicians neither rejected VC nor embraced it, but rather accepted it with caution and a reluctant attitude. They reasoned their attitude toward VC in various ways that were not entirely consistent. The way the clinicians reasoned their use of different modes of consultation appears to be paradoxical. On the one hand, while choosing PC over VC, they posited that VC could harm the quality of care in the long run. They argued that not being able to meet the patient in person could mean that the communication and interaction between the patient and clinicians become less rich and informative. In contrast, they justified using TC over VC, positing that telephones are easier and more flexible to use, which implies that they did not value the ability to see the person on screen in VC. It seems that the clinicians were caught between the importance of seeing and meeting the patients during the consultation and the ease and flexibility of using a particular mode. Consequently, the clinicians have developed their personal favorites and preferences, which they justified using different reasonings.

Explanation of Choices Made by Clinicians

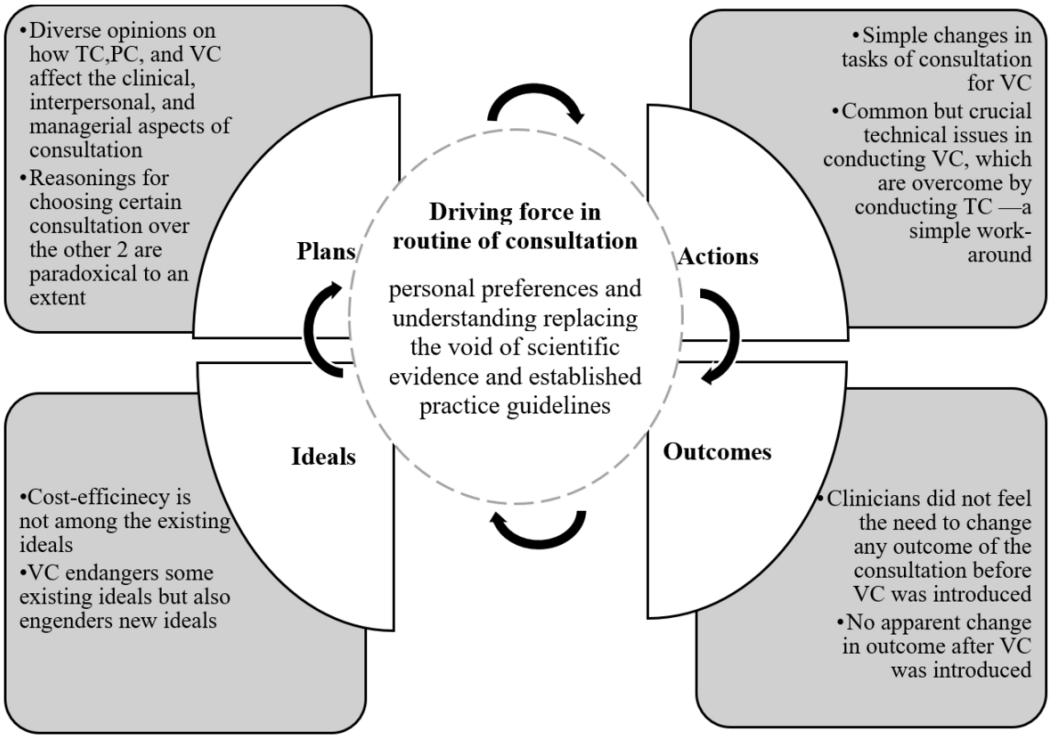
In this section, we provide a plausible explanation for the clinicians' diverse and inconsistent choices regarding consultation modes. When compared with health care technology, such as a minimally invasive cardiac surgery technique [37], the technology for VC requires only simple changes in clinicians' routines. Studies have shown that technology that causes disruptive changes in routine actions or limits professional autonomy is harder to implement and often ends up being abandoned or used in a limited manner, as opposed to finding large-scale application [10,37,38]. In the case of adopting VC, the clinicians did not feel that their roles or professional autonomy had been altered in any way, and they did not feel the need for formal learning or training to conduct VC. Therefore, VC was not dismissed by clinicians because of disruptive change in routines. Although VC implementation does not provide any strong reason to dismiss it, it does not provide any explicit benefit for the clinicians to adopt it immediately. We cannot ignore the growing number of randomized controlled trial studies that show how VC impacts diagnosis-specific clinical efficacy and safety [39,40]. However,

there is an increasing discrepancy between experimental trials and the experience of remote consultation as a regular service [12,41,42]. The clinicians in our study wondered about the long-term effects of VC on the quality of care. Moreover, we identified that it is not only how VC impacts the clinical aspect that needs to be considered but also how it impacts the interpersonal and managerial aspects. Scientific evidence on the long-term effect of VC on all the three aspects is inadequate according to clinicians in our study, and this is consistent with previous studies [41,42].

Another important issue to consider is that the objective of VC implementation in the hospital was primarily economic, a factor that the clinicians did not feel strongly or care about in terms of treating patients. Other interventions, such as computed tomography scanners [43] or minimally invasive surgery techniques [37], have demonstrated clear improvements in the level of clinical care from the beginning of their implementation. Previous studies have shown that when medical professionals realize that an intervention can improve their clinical practices, they are less dismissive of the changes and eager to incorporate the new practice while trying to minimize the changes in their routine [15]. VC does not offer any such explicit incentive to clinicians. Therefore, the clinicians have not embraced this new mode of consultation with much enthusiasm, which explains why the clinicians were not using VC to a great extent before lockdowns were imposed in March 2020.

We posit that the absence of sufficient scientific evidence, clear understanding of the merits and demerits of VC, and standard practices and shared norms for conducting VCs have created a void in the consultation practice. This void leads clinicians to use their personal judgments and preferences to justify their choices regarding PC, VC, and TC. Thus, a wide variety of moderately paradoxical reasons can be identified from the clinicians' accounts of how they choose the mode of consultation. This void—created by lack of evidence and standard practice and shared norms—is a unique phenomenon for clinical practice. These factors are the pillars of the medical profession, and they drive the medical practitioners' decision-making [14,44]. In the absence of these pillars, each clinician uses their professional autonomy and agency to interpret the effects of VC and decide how and when to use each consultation method [45]. This explains the variety and paradoxes seen in their reasoning regarding the choice of consultation. Figure 2 shows an updated framework for the routine of consultation (ie, findings in plans, actions, outcomes, and ideals) and the driving force behind the current routine that incorporates all three modes of consultation.

Figure 2. Performative model of routine for services using in-person consultation (PC), telephone consultation (TC), and video consultation (VC).



Comparison With Previous Studies

The literature relevant to VC has been discussed previously; therefore, in this section, we compare this study with previous studies focusing on clinicians. One of these studies [2] examined how clinicians perceive the limitations of VC and how the relationship between clinicians and patients may change when VC replaces PC. The primary finding was the set of disturbances

and limitations experienced by clinicians who have experienced VC. The study provided in-depth analysis of the disturbances and limitations of VC and revealed the consequences of the consultation if such disturbances persist. Moreover, the study also identified that the responsibility of creating a suitable ambiance for consultation is shared by both the clinician and patient in VCs, proposing that if clinicians do not consider the patient's ability to create a suitable environment, the consultation may have reduced quality. A second study conducted by the same group of researchers focused specifically on the selection criteria clinicians used to choose patients for VC [46]. Our findings confirm the selection criteria used by the clinicians in their study when choosing patients. However, our study further generates new insights by examining how clinicians navigate through a consultation service when they have three alternative modes to provide the service.

First, we examined clinicians' choices, not only regarding VC but also regarding the total service (ie, PC, TC, and VC), showing that the availability of TC along with PC adds paradoxes in clinicians' choice of consultation. By using a performative model of routine as the theoretical lens, we then identified how clinicians compare the goal of VC with their ideals and expected outcomes of consultations and, consequently, plan and conduct the consultations. Thus, in addition to the barriers and patient selection criteria, our analysis identified other criteria for choosing the consultation mode, including interpersonal and managerial ones and a clinician's personal preferences and previous experience with TC. Our analysis of an individual clinician's routine of consultation also reveals the wide variations that exists in clinicians' sense-making processes regarding the different modes of consultation and their opinions on the potential benefits and harms these modes can cause. Finally, we provide a plausible explanation for the varied and moderately paradoxical opinions of clinicians by using the literature on the medical profession and professional organizations.

Strengths and Limitations of the Study

This study contributes to the eHealth literature by generating deeper insights into clinicians' decision-making processes regarding remote and PC, which has significant effect on the sustainability of the large-scale implementation of remote consultations. Once the variety in clinicians' opinions about the different consultations can be minimized, the uncertainty of how and when to use each mode of consultation can be reduced, making it more likely that all modes of consultation will become routine (ie, the flow of actions without a less active comparison between outcomes and ideals and adjustments in plans) [47], hence, making it become sustainable. We argue that to minimize the variety in opinion, clinicians require the scientific, long-term evidence on the effect of VC and TC not only on clinical but also on interpersonal and managerial aspects of the consultation, which have not been in focus in the literature.

Moreover, our findings are useful for health care IT implementation in general. To advance IT implementation practice and research, it is essential to identify the theoretical mechanisms and contingencies of IT implementation [27]. This is not addressed by most of the current health care IT literature [48,49]. We provide an explanation for the low number of large-scale IT adoption and sustainable implementation projects in health care organizations: when the objective of an IT implementation program is not directly aligned with the ideals that clinicians hold for a certain health care service, clinicians do not immediately welcome the implementation, even if the IT does not threaten their professional autonomy or complicate their existing routines. Instead, they seek reasons to dismiss or adopt it. In these situations, if enough evidence or uniform understanding of the benefit and harm caused by the IT is nonexistent, the professionals can rely on their individual judgment and personal preferences to decide how and to what extent they adopt the IT. Consequently, diverse opinions emerge, including some paradoxical ones, resulting in an uncertain future for sustainable large-scale implementation.

The limitation of this study is that it focuses on a single health care organization. Although the chosen organization is one of the largest and most prominent hospitals in Norway, one can question the extent to which our findings and explanations are valid for other hospitals worldwide. To minimize this limitation and enhance the usability of the study, we provided a detailed description [50] of the national and local contexts of the hospital. We aimed to provide readers with good understanding of the context and demonstrate that the findings and explanations are embedded within the context. Thus, the findings of this study can be compared and contrasted with those of future studies from similar or different contexts.

Directions for Future Studies

We posit that it is crucial to investigate and identify the efficacy of remote consultations in their entirety so that the potential benefits can be realized and exploited to the maximum and the potential harms can be minimized. Our findings emphasize the need for future studies on VC in several directions: (1) the long-term clinical effect of remote consultation (eg, VC and TC), (2) the effect on the interpersonal aspects of consultations and how these aspects affect the quality of care in consultation, and (3) the effect on managerial aspects and how remote consultation can improve the management and organization of consultation services. Studies conducted in these directions can help provide scientific evidence for a different mode of consultation and a strong base to generate, share, and help to develop the values and norms about how clinicians practice consultations using multiple modes.

Our study also reveals that besides conducting studies in these areas, a strong focus is needed on how to disseminate these findings among clinicians. If clinicians are not aware of the scientific evidence, their process of choosing the consultation mode will remain the same. On the one hand, a separate stream of research on how to disseminate scientific evidence and good practices for different consultation modes would be beneficial. In contrast, as a crucial step in implementing VC, the management of the hospital needs to consider facilitating learning, sharing of experiences (good or bad), and dissemination of research.

Conclusions

The research and practitioner communities worldwide are deeply engaged in anticipating how VC will be adopted in hospitals as a regular service and how it will change the consultation service. This study contributes to this ongoing conversation by including new insights into how, on a daily basis, clinicians make sense of the availability of the three modes of consultation (ie, PC, TC, and VC) and how they reason their choice of a mode over others. We conclude that as a digital intervention, VC does not drastically change the routine of consultation for clinicians. However, it also does not provide an immediate clinical benefit. Thus, clinicians neither dismiss the option of VC nor feel an urgency to adopt it. The study also revealed the absence of sufficient scientific evidence on the long-term merits and demerits of VC, standard practice, and shared norms regarding when to use (and not to use) VC. Under this circumstance, clinicians tend to rely on their personal assessment and preferences to decide the mode of consultation, which leads to wide variety in clinicians' choice of consultation mode. This variety risks the quality of the consultation service and patient satisfaction because patients with similar diagnoses may receive different forms of health care, depending on the clinicians they are consulting. Therefore, this study calls for future studies on the long-term effect of VC, not only regarding clinical attributes but also interpersonal and managerial attributes. We also emphasize that the dissemination of these studies among clinicians is equally important because these results can answer the questions they ask about the long-term effect of VCs, and consequently, develop best practices and share the norms for this digital service.

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Conflicts of Interest

None declared.

Multimedia Appendix 1

Interview guide consisting of three sets of questions for clinicians, patients, and advisers.
[DOCX File , 20 KB-Multimedia Appendix 1]

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Abbreviations

IT: information technology
NSD: Norwegian Center for Research Data
PC: in-person consultation
REK: Regional Committee for Medical and Health Research Ethics
TC: telephone consultation
VC: video consultation

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Paper IV

Multichannel consultation service design in hospitals: implications for service efficiency and effectiveness

Abstract

Purpose: The purpose of this study is to identify how to design multichannel video, telephone, and in-person consultations in hospitals and how different designs can affect the efficiency and effectiveness of this service.

Methodology: A multiple-case design was employed. The unit of analysis was the multichannel consultation pathway, and 20 pathways were mapped to identify patterns of using different channels in consultation services. The perspectives of different stakeholders (patients, clinicians, and managers) were analyzed to understand the reasoning behind these patterns.

Findings: This study puts forward (1) the main constructs of designing and evaluating multichannel consultation services based on multichannel service literature and task-technology fit theory; (2) four strategies to use multiple channels for consultation services, namely service cost reduction, responsive care provision, convenience enhancement, and service experience augmentation; and (3) five propositions to design multichannel consultations.

Originality: This is the first study to consider both remote and in-person consultations to design a multichannel consultation service. We were able to demonstrate remote consultations' potential in reaching hospitals' strategic priorities and mitigating the trade-off between service efficiency and effectiveness.

Research implication: This study contributes to the service operations management literature by identifying novel insights on a distinct multichannel service. The need for highly customized care and the presence of clinicians as professional experts and co-users of the channels require unique considerations when designing this service.

Keywords: Remote consultation, multichannel, service design, efficiency, effectiveness, trade-off

Article classification: Research paper

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