THESIS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

Achieving swift and even hospital-wide patient flows

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Abstract

Healthcare systems worldwide face mounting challenges as surging demand outpaces care delivery capacity. This imbalance leads to longer waiting times for consultations and surgeries, as well as overcrowded emergency departments and wards. Meanwhile, healthcare costs continue to rise as a share of GDP, underscoring the urgent need for innovative solutions. Over the past two decades, practitioners and researchers have focused on patient flow optimization to improve hospital throughput. Yet, most improvement efforts have been local, targeting specific units rather than adopting a hospital-wide perspective. This dissertation addresses this gap by investigating patient flow comprehensively, identifying key barriers, and with contributing new knowledge on enhancing hospital-wide efficiency.

To explore this, five studies were conducted, each offering distinct perspectives. Study I, a systematic literature review, maps barriers and root causes. Study II, an international interview study with senior executives, examines solution strategies. Study III, a single-case study of a full-service clinic, investigates the impact of patient volume, variability, and complexity. Study IV, an international multiple-case study of leading hospitals, explores decision-making authority and governance structures. Study V, a multi-site interview study with frontline professionals, provides insights from nurses and physicians.

Synthesizing findings across these studies, this dissertation advances both theory and practice by applying a systems perspective to the complexity of patient flow. The theoretical contribution lies in employing operations management theories to healthcare, highlighting context-specific challenges hospitals face in maintaining smooth flows. The research identifies a multi-level system of barriers, often producing unintended consequences when well-intended initiatives lead to suboptimal outcomes. In this intricate context, continuous trade-offs arise between individual patient needs and population-level efficiency, with decentralized decisions frequently resulting in poor resource utilization. Optimizing patient flow requires hospitals to adopt a dual approach: combining flexibility and autonomy with centralization and structure to safeguard overall efficiency.

The practical contributions offer policymakers and hospital leaders actionable frameworks for diagnosing flow-related barriers, designing effective strategies, and tailoring processes to patient volume and complexity. These insights provide a foundation for improving hospital-wide throughput and addressing the pressing challenges facing modern healthcare systems.

Keywords: *Patient flow, Hospital-wide, Healthcare, Productivity, Efficiency, Patient logistics*

Sammanfattning

Hälso- och sjukvårdssystem världen över står inför växande utmaningar när den ökande efterfrågan överstiger vårdens kapacitet. Denna obalans leder till längre väntetider för konsultationer och operationer samt överfulla akutmottagningar och vårdavdelningar. Samtidigt fortsätter vårdkostnaderna att öka som andel av BNP, vilket understryker det akuta behovet av innovativa lösningar. Under de senaste två decennierna har både praktiker och forskare fokuserat på optimering av patientflöden för att förbättra sjukhusens kapacitet. De flesta förbättringsinsatser har dock varit lokala och inriktade på enskilda enheter snarare än att anta ett sjukhusövergripande perspektiv. Denna avhandling adresserar denna brist genom att undersöka patientflöden ur ett helhetsperspektiv, identifiera centrala hinder och bidra med ny kunskap om hur effektiviteten i sjukhusövergripande flöden kan förbättras.

För att undersöka detta genomfördes fem studier med olika perspektiv. Studie I, en systematisk litteraturöversikt, kartlägger hinder och deras bakomliggande orsaker. Studie II, en internationell intervjustudie med högre sjukhusledare, analyserar lösningsstrategier. Studie III, en fallstudie av en "full-service" klinik, undersöker effekterna av patientvolym, variation och komplexitet. Studie IV, en internationell flerfallsstudie av ledande sjukhus, analyserar beslutsmandat och styrningsstrukturer. Slutligen ger Studie V, en intervjustudie på flera sjukhus med vårdpersonal i frontlinjen, insikter från sjuksköterskor och läkare.

Genom att syntetisera resultaten från dessa studier bidrar avhandlingen till både teori och praktik genom att tillämpa ett systemperspektiv på patientflödets komplexitet. Det teoretiska bidraget ligger i att använda operations management-teorier inom vården och därigenom belysa kontextspecifika utmaningar för att upprätthålla jämna flöden. Forskningen identifierar ett flernivåekosystem av hinder, som ofta leder till oavsiktliga konsekvenser där välmenande initiativ får suboptimala effekter. I denna komplexa kontext uppstår kontinuerliga avvägningar mellan enskilda patienters behov och effektivitet på befolkningsnivå, där decentraliserade beslut ofta resulterar i bristfällig resursanvändning. För att optimera patientflöden måste sjukhus därför anta en dubbel strategi: att kombinera flexibilitet och autonomi med centralisering och struktur för att säkra systemeffektiviteten.

De praktiska bidragen erbjuder beslutsfattare och sjukhusledare konkreta ramverk för att identifiera flödesrelaterade hinder, utforma effektiva strategier och anpassa processer till patientvolym och komplexitet. Dessa insikter utgör en grund för att förbättra sjukhusövergripande kapacitet och möta de akuta utmaningar som dagens hälso- och sjukvård står inför.

Appended papers

Paper I

Åhlin, P., Almström, P. & Wänström, C. (2022). When patients get stuck: A systematic literature review on throughput barriers in hospital-wide patient processes. *Health Policy, 126, 2, 87-98.*

Contributions: Philip Åhlin was the main author, initiated and designed the study, collected data, conducted analysis, and co-wrote the paper. Peter Almström and Carl Wänström participated in the study design, data analysis, and writing of the paper.

Paper II

Åhlin, P., Almström, P. & Wänström, C. (2023). Solutions for improved hospital-wide patient flows – a qualitative interview study of leading healthcare providers. *BMC Health Services Research, 23, 17.*

Contributions: Philip Åhlin was the main author, initiated and designed the study, collected data, conducted analysis, and co-wrote the paper. Peter Almström and Carl Wänström participated in the study design, data analysis, and writing of the paper.

Paper III

Åhlin, P., Hermansson, S. & Almström, P. Focused operations to improve the patient flow in full-service healthcare organizations. Currently under review at *Production Planning & Control, a previous version presented at EurOMA conference 2023*

Contributions: Philip Åhlin was the main author, initiated and designed the study, collected data, conducted analysis, and co-wrote the paper. Simon Hermansson and Peter Almström participated in the study design, data collection, data analysis, and writing of the paper.

Paper IV

Åhlin, P., Almström, P. & Wänström, C. Operationalizing hospital-wide patient flows: A multiple-case study of leading academic hospitals. Currently under review at the *Journal of Operations Management, a previous version previously presented at EurOMA conference 2024*

Contributions: Philip Åhlin was the main author, initiated and designed the study, collected data, conducted analysis, and co-wrote the paper. Peter Almström and Carl Wänström participated in the study design, data analysis, and writing of the paper.

Paper V

Åhlin, P. Bottom-up perspectives on hospital-wide patient flow – A multi-site qualitative study of solutions to organizational paradoxes. Currently under review at *BMC Health Services Research*

Contributions: Philip Åhlin was the only author, and independently initiated and designed the study, collected data, conducted analysis, and wrote the paper.

Acknowledgments

I had never planned to pursue a doctorate; it never felt like a world where I truly belonged. As a newly graduated Master of Science in Industrial Engineering and Management, my ambition was to become a project manager, someone who would lead change and improvement initiatives in dynamic workplaces, tackling practical problems firmly rooted in real-world challenges. And that's exactly what would have happened, had I not met my great love and life partner, Sofia.

With Sofia, a physician and newly enrolled doctoral student, research and science became ever-present, not just in a professional sense, but as a natural and integral part of life itself. I followed her journey, and gradually, my own interest in and understanding of that world deepened. I came to realize that research both is, and must be, grounded in the real-world challenges we face, and that many complex, persistent problems can never be solved by eager, results-driven change leaders alone. We also need people who dare to take their time, who are willing to dig deep into the nature of things, and who can offer well-founded perspectives and conclusions, unburdened by immediate demands for performance gains.

Having witnessed and worked with severe, persistent problems in Swedish healthcare, I eventually decided I wanted to devote myself to researching these issues. Consequently, in February 2020, I began my doctoral studies at Chalmers University of Technology in Gothenburg. Without you, Sofia, this journey into research might never have begun. Thank you for making science a living, breathing part of everyday life, for making it feel ever relevant.

Throughout my doctoral journey, I have also been incredibly fortunate in having Peter Almström as my principal supervisor. Peter, you have always been available for any question, open to discussing my ideas, and a steady guide in scientific methods and theory. We have engaged in countless discussions about the challenges facing healthcare, and your wise perspectives are something I will always carry with me. Beyond the professional, I have equally appreciated our shared reflections on life as parents.

My sincere thanks also go to Carl Wänström, my co-supervisor, for your dedication to me and my research, and for your sensitive mediation between Peter and me whenever a third voice was needed to help us move forward.

Doctoral research is, for many, a solitary journey. It has been that for me, too, and perhaps it must be so. But I was lucky enough to start in the same year as five fellow doctoral students (Elin, Nils, Sandra, Hannes, and Carla). Together, we supported each other and shared experiences and perspectives. We reflected on what separates a "grand theory" from a "midrange theory," debated what counts as a "good enough" journal for submission, and helped one another navigate the competing pressures of deadlines. A special thank you goes to

Elin, who has been a trusted sounding board and provided invaluable feedback on my writing on countless occasions.

I would also like to thank Per Medbo for the many conversations we shared in the early mornings, before any of our colleagues had arrived at the office. Beyond the pleasure of those exchanges, you consistently encouraged me to view my research through a practical lens and helped me stay grounded in reality. Thank you for that.

In my final year as a doctoral student, I had the opportunity to spend a year at Universidad Politécnica de Madrid in Spain. That year taught me much about taking academic initiative and strengthened my confidence to become an independent researcher. Thank you, Miguel Ortega Mier, for welcoming me into your department and for the many enriching professional and personal conversations we shared. I am also grateful to my fellow doctoral colleagues, Carlos, David, and Ali, whose company and engaging discussions made my time in Madrid truly memorable.

Finally, I would like to extend my deepest gratitude to all the healthcare professionals I have had the privilege to meet and speak with during these years. Without you, this research journey would not have been possible. I am deeply appreciative of all the inspiring conversations and of the unwavering engagement with my research, a recurring confirmation that my work is both relevant and needed. A particular thank you to Inga Lennes, former Vice President at Massachusetts General Hospital, whose enthusiasm during our interview gave me the courage to ask if I could visit Boston, an inquiry that ultimately led to an exciting multiple case study across the United States. You were a pivotal figure in making that happen. Thank you for recognizing me and my research.

Philip Åhlin

Gothenburg, September 2025

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Preface

Research can be conducted in many ways: it can be exploratory, seeking to understand emerging or poorly understood phenomena; it can be descriptive, aiming to explain how the world currently functions; or it can be prescriptive, suggesting how things ought to work. Each of these approaches is vital for generating new knowledge. However, when it comes to making a practical difference and influencing real-world practices, prescriptive research often plays a more impactful role. In light of this, intervention studies have become popular, they are used to demonstrate the relationship between introducing a new technology, method, or way of working, and improvements in performance. My research project was originally designed in exactly this way. I was hired as a PhD student for a five-year project, tasked with participating in and studying the design, implementation, and evaluation of a new production system at a highly specialized clinic in a Swedish university hospital. The project had been years in the making, with significant resources committed from both academia and the hospital to ensure its success. However, just two weeks after I began my doctoral studies, Sweden reported its first case of COVID-19. A month later, hospitals across the country were rapidly reorganized to cope with the explosive surge in cases, the pandemic had become a reality. All development projects at the hospital were put on hold, and our ambitious project (though we didn't know it at the time) would never be resumed. The funding was needed elsewhere.

Before beginning my PhD, I worked as a logistics specialist and internal consultant at a major Swedish university hospital. My role involved supporting clinics with improvement efforts related to logistics and process development, as well as capacity and demand analyses. One thing struck me wherever I worked: the patient flow was extremely fragmented, with minimal central coordination, despite the fact that patients often moved between several departments and clinics during their hospital journey. I quickly realized this wasn't a new problem. Hospitals have always been specialized, decentralized, and fragmented by design. While this has clearly benefited the specialists, I couldn't help but question whether it truly serves the patients. When the pandemic hit and the production system project was scrapped, it became clear to me that my "temporary" project (that was going to become my permanent one) would concern how to enable hospital-wide patient flows. Over the past few years, as I've delved into the topic of patient flows across hospitals, I've been struck by how timely and relevant this issue appears to be, or perhaps it always has been. No matter which hospital I've visited or whom I've spoken with, from nursing assistants and surgical nurses to senior emergency physicians and hospital executives, everyone has responded with enthusiasm and interest when I've described my project. There seems to be a widespread consensus that things need to change. The system must become more integrated and better coordinated. At the same time, many fear that change could make things worse. Healthcare professionals are already stretched thin, working hard to maintain the high standard of care we've come to expect across the Western world. While my research has not been prescriptive, it has allowed me to explore and describe how future hospitals might be designed to improve patient flows across the entire organization.

1 Introduction

1.1 Introducing the capacity-demand imbalance

A ticking time bomb, that is how Hans Kluge, the World Health Organisation's (WHO) regional director for Europe, describes Western healthcare systems, which are facing unprecedented challenges as demand far outpaces available capacity (Henley et al., 2022). The rising demand for healthcare has multiple causes. In Europe and the US, however, it is closely tied to an aging and increasingly ill population requiring care for multiple simultaneous health conditions (OECD, 2024c, CommonWealthFund, 2023). The European Commission estimates that the proportion of Europeans over 65 will grow by 10% between 2018 and 2050 (Eurostat, 2015). In Sweden, the population over 85 is expected to increase by as much as 130% in the coming decades (SCB, 2015). This demographic shift puts a significant burden on healthcare systems, as individuals over 65 consume healthcare resources at four times the rate of younger populations (Williams et al., 2019). Moreover, WHO projects that 40% of Europeans over 15 will have at least one chronic illness, while two-thirds of those over 65 will, on average, suffer from two or more chronic conditions (WHO, 2014).

This growing demand pressures healthcare systems to expand capacity and resources. Although employment in the health and social care sector across Europe has increased from 8.5% of the labor market in 2002 to 10.2% in 2022, even the best-resourced health systems are struggling to keep up with the rapidly rising demand (OECD, 2024c). By 2030, the projected shortage in OECD countries will reach 400,000 doctors and 2.5 million nurses (Scheffler and Arnold, 2019). Furthermore, healthcare workers are increasingly burdened by overwhelming workloads and stressful environments, leading to burnout, illness, or career changes (WHO, 2024). This is particularly concerning, given that by 2022 more than one-third of doctors and a quarter of nurses in the EU were aged 55 or older and nearing retirement (OECD, 2024c).

The capacity-demand imbalance has direct consequences for populations across OECD countries, with rising waiting times and a reduced ability to provide timely, appropriate care (OECD, 2020, Davis et al., 2019, Siciliani et al., 2014). In the UK, the number of patients waiting more than 18 weeks for a first appointment or surgery has increased from 200,000 in 2013 to 3.3 million in 2023, while waiting lists have tripled over the same period (NHS, 2023). In Sweden, the number of patients waiting more than 90 days for a first appointment, surgery, or specialized care has risen steadily every year from 2012 to 2021 (SKR, 2022b). On average, waiting times have increased across the OECD since 2010, with a sharp spike during the 2020–2021 pandemic, which further exacerbated the crisis (OECD, 2023b, OECD, 2020). Another contributing factor to the growing waiting times may be stagnating or declining productivity in the healthcare sector. According to the US Bureau of Labor Statistics, between 2007 and 2019, labor productivity in community hospitals, measured as hospital output per hour worked, grew by just 0.2% annually (BLS, 2024). In Sweden, the number of in-person doctor consultations per year decreased by an average of 1.5% annually between 2012 and 2021 (SKR, 2022a), a trend mirrored in many OECD countries between 2011 and 2021 (OECD, 2023a).

At the same time, the share of national GDP spent on healthcare in OECD countries has steadily increased and is projected to rise from 8.8% in 2018 to 11.8% by 2035. In Sweden, healthcare spending is expected to grow from 11% to 13%, while in the US, it will rise from 16.8% to 20.2% (OECD, 2024a). This growth is driven not only by an aging population and a larger healthcare workforce but also by advances in medical technology, which amplify demand and drive up costs. As healthcare expenditures rise, policymakers have become increasingly reluctant to allow further growth, despite mounting pressure from the healthcare sector (OECD, 2024b, Lorenzoni et al., 2019).

Healthcare demand is rising rapidly, the staffing shortage is worsening, waiting times are lengthening, and policymakers are hesitant to increase healthcare funding beyond inflation adjustments. Consequently, healthcare providers must find new ways to expand output capacity, meaning the number of patients treated over a given timeframe, without raising costs, that is, by improving productivity and delivering more care with the same amount of resources or available input capacity. This effort must also be accompanied by solutions that reduce the burden on healthcare professionals to prevent further resignations and workforce attrition.

1.2 Introducing the hospital-wide patient flow

The growing mismatch between healthcare demand and available capacity highlights the urgent need for solutions to improve the number of patients treated per day and year without further straining resources. One way to address this challenge is by exploring how to enhance hospital productivity (De Regge et al., 2019, Devaraj et al., 2013, Gualandi et al., 2019, Johnson et al., 2020, Villa et al., 2014, Vissers et al., 2023). Productivity revolves around two interrelated and fundamental principles: a) enabling units to flow as quickly as possible through a process and b) minimizing variation in quantity, quality, and timing (Schmenner, 2015). Schmenner and Swink (1998) summarize this: "the more swift and even the flow goes through a process, the more productive that process is". Applied to healthcare, improving productivity is broadly understood as facilitating a seamless trajectory of care from admission to discharge with minimal deviations in the process (Johnson et al., 2020). Efforts to reduce variation in healthcare and to streamline patient flows may initially appear counterintuitive, particularly when conflated with the concept of demand variety, often viewed as inherent and essential to the healthcare sector. However, enhancing the evenness of patient flow primarily concerns the reduction of internal variation, specifically in terms of quantity, quality, and timing, arising from the management and scheduling of internal resources. This internal variation, rather than external demand variety, represents a persistent challenge within healthcare systems (De Regge et al., 2019, Hall et al., 2013, Villa, 2022).

Over the past two decades, there has been growing interest in improving healthcare productivity by focusing on patient flow, i.e., increasing the throughput of patients through hospitals (Gualandi et al., 2019, Johnson et al., 2020, Villa et al., 2014). Studies have shown

that focusing on and better understanding patient flow can positively impact the speed with which patients progress toward discharge (Improta et al., 2018). Moreover, a focus on patient flow can help manage fluctuations in patient numbers along the care continuum, particularly in resource-constrained healthcare systems (Gualandi et al., 2019). Additionally, a slow patient flow exposes patients to unnecessary risks of iatrogenic complications such as infections (Devaraj et al., 2013). Consequently, improving patient flow is recognized as essential not only for enhancing productivity but also for improving medical quality, patient safety, and patient satisfaction (Improta et al., 2018, Lovett et al., 2016a).

However, treating a wide range of diseases and conditions means there is no single, standardized patient process or pathway (Glouberman and Mintzberg, 2001, Persis et al., 2020). Instead, hospitals resemble "immensely complicated processing plants, with thousands of parallel, often complex and interlocking processes" (Rechel et al., 2010). In this context, Vissers et al. (2010) and Litvak and Bisognano (2011) have previously emphasized the importance of adopting a system-wide perspective when seeking to improve patient flow across hospitals. This approach highlights the need to address problems and bottlenecks that arise throughout the continuum of care within the organization (Kreindler, 2017). A hospital's numerous clinics and medical units, all of which care for the patient at different stages between admission and discharge, must align their objectives to make the hospital more efficient and effective in delivering the right care at the right time, place, and cost (Devaraj et al., 2013, Gualandi et al., 2019). Despite widespread recognition of the importance of a system-wide approach to improving patient flow, such an approach is often applied only superficially. Frequently, it is invoked merely to indicate that effective flow improvements necessitate interventions across multiple parts of the healthcare system (Kreindler, 2017). A key reason for this limited application is the difficulty healthcare managers face in adopting a comprehensive, hospital-wide perspective on patient flow. This, in turn, poses challenges for researchers attempting to observe, analyze, and draw conclusions from such initiatives. However, hospitals are often internally divided, with different departments and clinics pursuing separate goals and competing for shared resources and services (Glouberman and Mintzberg, 2001, Porter, 2010, Radnor et al., 2012). As a result, studies on patient flow improvements rarely consider the entire patient journey from admission to discharge (Radnor et al., 2012, D'Andreamatteo et al., 2015). Most research focuses instead on narrower scopes, such as patient flow within a single clinic or unit (D'Andreamatteo et al., 2015, Gualandi et al., 2019, Villa et al., 2014).

In this context, there is a need for research that adopts a hospital-wide perspective on patient flow and healthcare productivity. Previous studies call for more evidence-based research to develop better guidelines for managing the complex, interdependent processes across hospitals (Gualandi et al., 2019, Johnson et al., 2020, Villa et al., 2014, Thomas Craig et al., 2020, Vos et al., 2011). A comprehensive, hospital-wide view of the multiple emergent and planned patient flows across a healthcare organization is rarely addressed, leading to suboptimizations and inefficiencies in patient journeys (Glouberman and Mintzberg, 2001, Litvak and

Bisognano, 2011, Vos et al., 2011, van Lent et al., 2012). Taking a system-based approach to studying how different parts of the hospital interact throughout the patient process can open new possibilities for improving hospital-wide patient flows and, ultimately, population health by enhancing access to care (Glouberman and Mintzberg, 2001, Kreindler, 2017).

1.3 Purpose of thesis

Despite the growing focus on efficiency and productivity in healthcare, there remains a notable gap in theoretical, conceptual, and empirical research on hospital-wide patient flows (Gualandi et al., 2019, Kreindler, 2017, Litvak and Bisognano, 2011, Villa et al., 2014, Vissers et al., 2010). Improving patient flow on an organization-wide scale requires a broad systems perspective, one that considers the interdependencies between different units, medical specialties, and care pathways. Without a comprehensive understanding of these interconnections, hospitals risk implementing fragmented solutions that optimize individual processes at the expense of overall efficiency.

Given the increasing strain on healthcare systems due to rising demand, workforce shortages, and financial constraints, it is imperative to explore how hospitals can enhance patient flow in a way that improves both productivity and care quality (Improta et al., 2018, Scheffler and Arnold, 2019, Siciliani et al., 2014). At the center is also the need to make the flow of patients not only more swift but also more even, as healthcare struggles with more and less controllable demand variation than other industries (Dobrzykowski and Tarafdar, 2015). A more integrated approach to patient flow management could enable better resource allocation, reduce waiting times, and improve the patient experience while alleviating some of the burden on healthcare professionals. However, achieving this requires identifying both the barriers that hinder hospital-wide flow improvements and the factors that facilitate more seamless, coordinated care processes (Devaraj et al., 2013, Goldratt and Cox, 2014, Holweg et al., 2018).

By adopting a broader analytical lens, this research aims to provide insights into how healthcare actors can better align their activities and collaborate across different hospital functions to enhance efficiency. A deeper exploration of organization-wide patient flow can offer valuable knowledge to hospital administrators, policymakers, and healthcare practitioners, guiding the development of strategies that optimize hospital operations without compromising care quality. In this context, there is a clear need for further research that not only examines the structural and operational factors influencing patient flow but also contributes to a more comprehensive framework for improving hospital-wide productivity.

The purpose of the research presented in this thesis is, therefore:

"To understand what hinders swift and even hospital-wide patient flows, and to contribute with new knowledge on how the hospital-wide flow of patients can be improved."

This purpose demonstrates the intention to identify best practices on how hospitals should approach the challenge of creating an efficient hospital-wide patient flow. It also points to the need to understand the ecosystem of surrounding activities and what requirements a flow focus puts on the hospital. To enhance the generalizability of the findings, this thesis focuses on general hospitals as the primary unit of analysis. These are full-service healthcare providers that deliver high-volume care to regional populations while also managing significant variation and complexity in patient needs. Furthermore, the research adopts an international perspective by examining hospitals across multiple countries, recognizing that the challenges confronting healthcare systems are felt globally.

1.4 Research questions

Efficient patient flow is essential for hospital productivity, as bottlenecks and inefficiencies can lead to a reduced number of patients treated per day and year, increased wait times, and suboptimal resource utilization (Litvak and Bisognano, 2011, Toussaint and Berry, 2013). Research highlights that hospitals face systemic barriers to efficient patient throughput, including resource constraints, workflow misalignments, and poor coordination across units (Mazzocato et al., 2010, van Lent et al., 2012). While many studies examine specific departmental inefficiencies, fewer have taken a hospital-wide perspective, which is necessary given that disruptions in one area often propagate throughout the system (Kreindler, 2017, Litvak and Bisognano, 2011, Vissers et al., 2010). By identifying root causes, rather than merely addressing symptoms, hospitals can implement targeted process improvements that enhance capacity without requiring significant cost increases (Holweg et al., 2018). Given the increasing patient demand and constrained resources in many healthcare systems, understanding these fundamental barriers is critical to improving hospital-wide productivity (Devaraj et al., 2013). The first research question is thus motivated by the need for a comprehensive analysis of system-wide inefficiencies and their broader implications for hospital performance.

RQ1: What barriers and underlying root causes impede swift and even hospital-wide patient flows?

While identifying barriers and root causes to swift and even hospital-wide patient flows is crucial for understanding the challenges faced, it is only part of the equation. To ensure that healthcare systems can effectively manage patient flow and improve overall service delivery, it is equally important to explore potential solutions and improvement strategies. Addressing these barriers requires not only awareness of the issues but also practical, researched interventions aimed at enhancing patient flow efficiency. Therefore, the second research question aims to investigate strategies and best practices that can be implemented to mitigate the identified barriers, ultimately contributing to increasing the performance of healthcare systems. Furthermore, concerning the need for the healthcare industry to increase productivity without raising costs, there is also a focus on identifying effective and actionable solutions that will either make a

considerable difference or may be implemented in a shorter time frame and require fewer investments in new resources.

RQ2: What solutions and improvement strategies can effectively address existing barriers to swift and even hospital-wide patient flows?

1.5 Structure of thesis

This thesis begins by explaining the background of the present healthcare crisis and how more eyes are directed towards the improvement of patient flows from a system-wide perspective, as a means of increasing healthcare productivity. This leads to the presentation of the purpose, research questions, and limitations of the study. The first chapter is then followed by an overview of how to conceptualize the flow of patients, the principles of process theory, the theoretical considerations of healthcare operations management, and the theory of swift and even flow. This is then followed by research methodology, explaining how and why the research design was chosen. After the chapter on methodology, a summary of the appended papers is presented, followed by a general discussion of the findings from the included papers. This thesis concludes with contributions, limitations, and suggestions for future research.

2 Frame of reference

The frame of reference guiding this research begins by outlining the performance requirements established by the World Health Organization for healthcare systems, particularly those related to patient throughput within hospital organizations. These requirements are then explained and conceptualized from both a healthcare system perspective and an Operations Management (OM) perspective. The aim is to provide the reader with a clear understanding of the theoretical foundations underlying how OM principles have been applied to explore, comprehend, and analyze the healthcare context and its associated challenges.

2.1 Healthcare access and care processes

The World Health Organization defines effective health systems as those ensuring that healthcare services are accessible, equitable, efficient, affordable, and of high quality for all (WHO, 2025). Moreover, the Organization for Economic Cooperation and Development describes that healthcare accessibility is a central performance target for high-performing health systems, meaning that individuals should be able to obtain the healthcare service they need when they need it, regardless of geographical location, financial status, or social or cultural background (OECD, 2023a). While quality focuses on the standards of healthcare services, their effectiveness, safety, and user experience, access refers to the extent to which health services are available and accessible in a timely manner (Figueras et al., 2024). With little access to healthcare, high-quality standards don't bring great health outcomes to the population served. Hence, improving healthcare access is intrinsic to any high-performing healthcare system serving a large and general population.

If the healthcare need of a patient is merely to receive advice from a physician concerning a particular ailment as a one-time healthcare system visit, then access may be less cumbersome to provide. However, access to healthcare must be seen from a broader perspective concerning access to all appointments, surgeries, and examinations in a timely manner to effectively care for patients throughout their complete care journeys (Gualandi et al., 2019, Kreindler, 2017, Litvak and Bisognano, 2011). If patients can enter a healthcare system but experience long waits, delays in treatment, or bottlenecks, their access to care becomes meaningless (Hall et al., 2013). Access gets patients into the system, but to connect activities and ensure an efficient journey through the system, a continuous and efficient care process is needed. It may ensure that care is coordinated across different settings, from a primary care provider to a specialist, from a first appointment until follow-up after surgery, or from a hospital to home care, creating a seamless experience (Johnson et al., 2020, Villa et al., 2014). Opening a new clinic or health center increases access, but without a continuous and well-connected care process, the clinic or health center might struggle with long waiting times and poor healthcare quality (Hall et al., 2013). See Figure 1, outlining a connected care process.

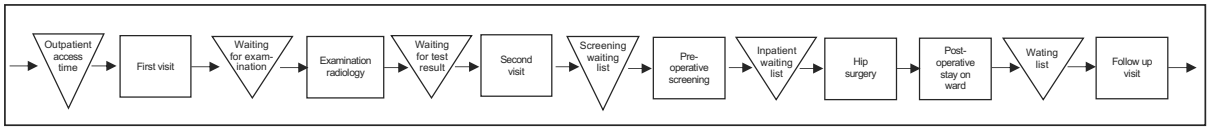

Figure 1: Visualization of a connected care process

A care process that a patient follows from a first appointment, through surgery, until a follow-up appointment is a presentation of a healthcare service that most people can appreciate. It is linear, has a clear start and end, and follows a logical care progression from a patient being sick to becoming healthy or healthier. It is also the general focus at healthcare clinics when they try to improve their services: to identify and visualize a certain care process; identify its bottlenecks; and implement change to resolve the present process barriers. However, healthcare services are never, or seldom, treating only one type of patient, suffering from only one type of ailment or disease. Instead, they most often treat a wide range of diseases and conditions, meaning there is no single, clear care process (Glouberman and Mintzberg, 2001, Persis et al., 2020). Healthcare services, and hospitals in particular, are instead hosting a myriad of emergent and planned care processes across their organizations and are analogous to "immensely complicated organizations, with thousands of parallel, often complex and interlocking, processes" (Rechel et al., 2010). Hospitals are also described as "the most complex human organizations ever devised" (Drucker, 2002). See Figure 2, visualizing the many emergent and planned care processes patients follow, in parallel, and between the various clinics and services of a hospital. In Figure 2, eight different settings are depicted: the emergency department (ED), the outpatient clinic, the operating room (OR), the intensive care unit (ICU), the pre-operative unit (Pre-OP), the post-anesthesia care unit (PACU), the inpatient wards, and the radiology department. The internal patient process, the supporting radiological process, and the external processes are also depicted in the model. Other ancillary processes, such as lab services, material replenishment, medical delivery, etc., are not included since they involve a patient only indirectly.

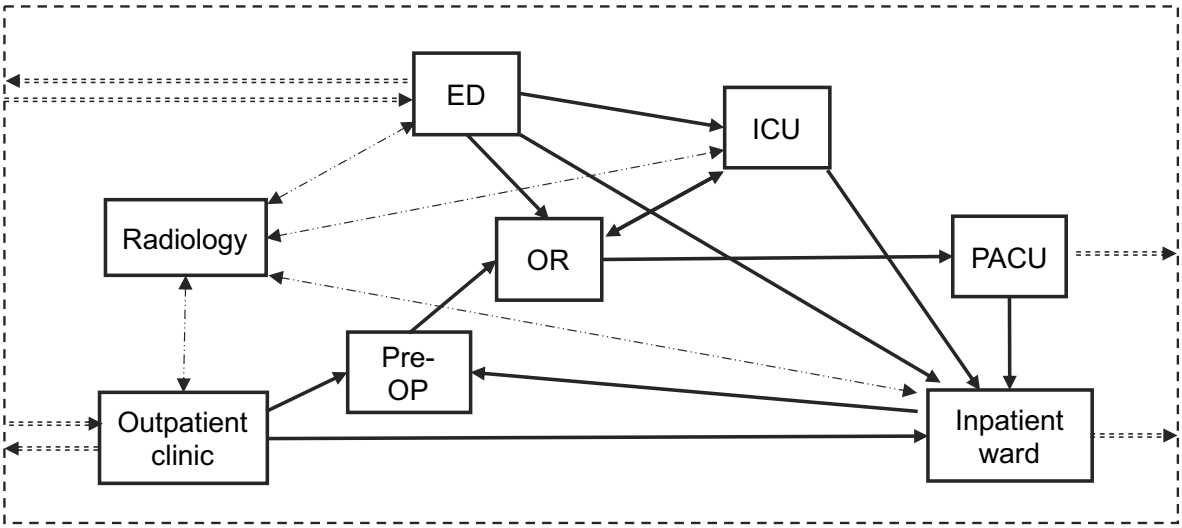

Figure 2: Visualization of parallel care processes in a hospital

Enabling access to healthcare might be less cumbersome in small organizations caring for a narrow patient group following a linear and short care process. However, most healthcare organizations are complex and require comprehensive approaches on how to improve their healthcare accessibility throughout long care processes for all types of patients, in a timely manner (Gualandi et al., 2019, Rechel et al., 2010).

2.2 The ontology of processes

A healthcare process involves, according to Campbell et al. (2000), interaction between users (patients) and the healthcare structure; in essence, what is done to or with users (patients). Processes in healthcare may also be referred to as care pathways or clinical protocols, outlining essential and connected steps in treating specific patient groups (Lawal et al., 2016). Processes, as a scientific phenomenon, are, however, found outside of care services and appear in most instances of life. A more general definition of a process is therefore needed. Holweg et al. (2018) define a process as "the sequence of activities that transforms inputs (or resources) into outputs (products or services), see Figure 3. It is the sequence of operations and involved events, taking up time, space, expertise, or other resources, that lead to the performance of some outcome.

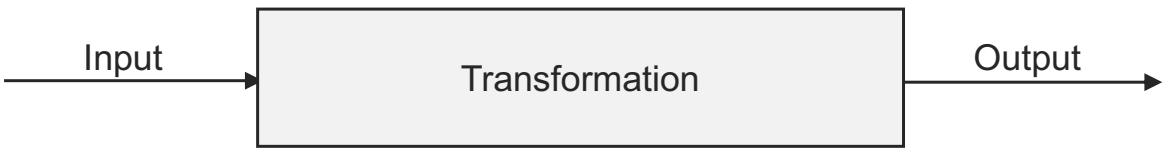

Figure 3: The process model

Seeing a patient as an input to a process seems misplaced for some, but it is the patient who presents a request for healthcare, where the output from a healthcare process might be that the patient is given a diagnosis, referred to another service, or cured (Vissers et al., 2023). Hence,

patient demand for care is the key input when a process is transforming inputs into outputs. With the inspiration from Vissers et al. (2023), this thesis presents a meta-process model of healthcare services that conceptualizes the healthcare system as a transformation process, see Figure 4. In this model, key inputs include patient demand (defined as perceived need), healthcare providers and hospitals (the actors involved in delivering care), purchasers (those who finance care), and suppliers (who provide the necessary resources for treatment). The transformation of these inputs into outcomes is facilitated by three interrelated types of processes: clinical processes, management processes, and ancillary processes. Together, these processes enable the production of key outputs, namely, a specific health status, patient (or client) experience, and the consumption of resources. While this transformation logic applies across processes of varying scale, from individual clinical pathways to organization-wide systems, the specific nature of inputs, transformation mechanisms, and outputs varies depending on the context and objectives of each process. Therefore, understanding the configuration and interplay of these elements is essential for analyzing and improving healthcare service delivery at all levels (Holweg et al., 2018).

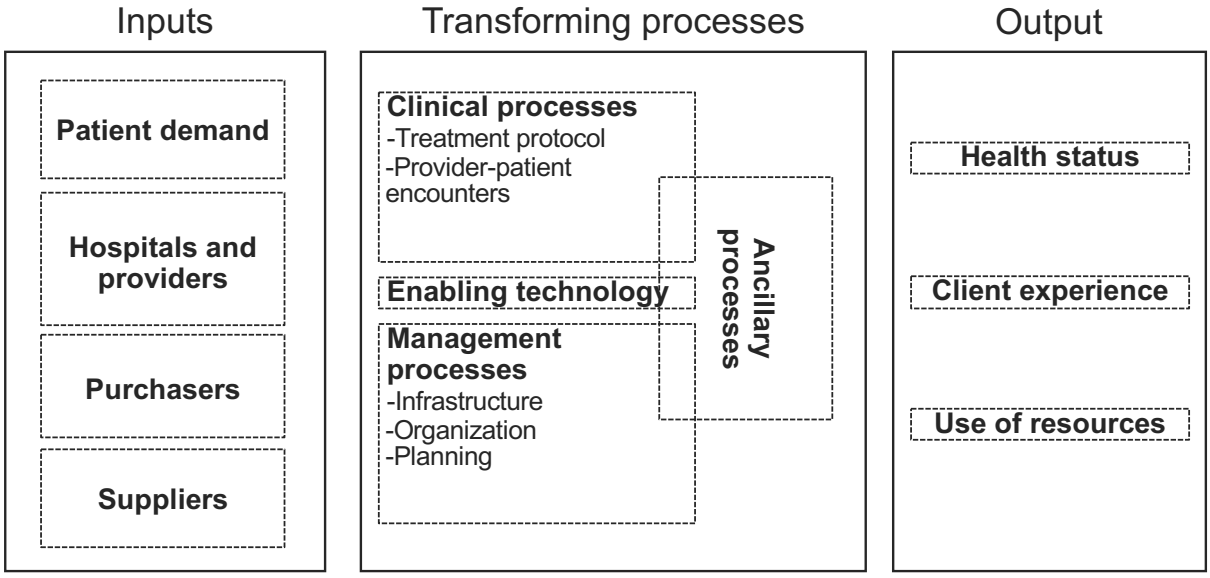

Figure 4: Meta-process model of healthcare services

2.3 The Theory of Processes

Healthcare consists of numerous interconnected processes that transform inputs (i.e., patients) into outputs, occurring both sequentially and in parallel (Glouberman and Mintzberg, 2001). However, every organization within any industry operates through its own unique set of interrelated processes, designed to produce the goods or services that meet its customers' (citizens, insurance companies, or society through public authorities, depending on the healthcare system) demand (Holweg et al., 2018). As a result, processes are structured in diverse ways to align with the specific context, culture, and strategy of a given organization. Despite

this variation, there are fundamental and generalizable principles governing process behaviour and optimal design (Holweg et al., 2018, Slack and Brandon-Jones, 2019). These principles, collectively referred to as process theory, have remained relevant over time, see Figure 5.

THE TEN PRINCIPLES OF PROCESS THEORY

Principle #1 - *All operations are composed of processes.*
Principle #2 - *Variation is inherent in all process inputs, tasks, and outputs.*
Principle #3 - *Work-in-process is determined by throughput rate and throughput time.*
Principle #4 - *Complexity in process design amplifies managerial challenges.*
Principle #5 - *Process choice requires fit between the task and the external requirements*
Principle #6 - *No single measure can capture the performance of a process.*
Principle #7 - *Process metrics can drive unintended behavior.*
Principle #8 - *Processes are improved by reductions in throughput time or in undesired variation.*
Principle #9 - *The rate of process improvement is subject to diminishing returns.*
Principle #10 - *Processes do not operate in isolation.*

Figure 5: The principles of process theory

The theory of processes tells us that processes (large or small) can be designed in multiple ways, but only a select few configurations ensure the optimal balance between available resources and external requirements. Identifying the most effective design requires analyzing a process in relation to the volume of units it handles and the variety of its products or services. As product or service variety increases, tasks within a process shift from being repetitive and simple to diverse and complex, while the process flow transitions from continuous to intermittent (Holweg et al., 2018), see Figure 6.

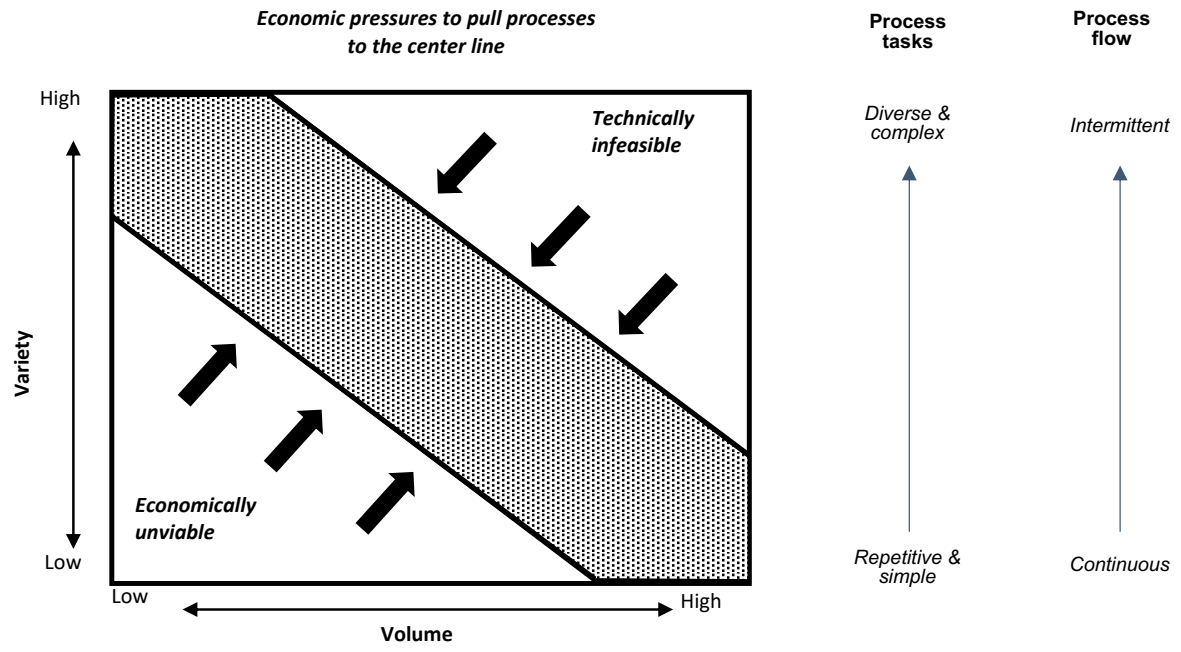

Figure 6: The volume-variety matrix

The design of manufacturing or service processes must account for these dimensions to ensure economic viability and technical feasibility (Holweg et al., 2018, Deming, 1982, Hayes and Wheelwright, 1979). The volume-variety matrix, Figure 6, a classical framework in operations management, underscores this and the necessity of aligning market strategy with production strategy to maintain competitiveness (Hayes and Wheelwright, 1979, Ahmad and Schroeder, 2002). Healthcare, however, is an industry that, many times, is at odds with these theories of how to organise to find an optimal balance between available resources and external requirements. Full-service general hospitals, the backbone of every healthcare system, are generally required, by local, regional, and national assignments, to account for complex, costly, and sick patients while also providing cost-efficient care to large, homogenous patient groups (Persis et al., 2020, Thirumalai and Devaraj, 2024). This means that these healthcare providers, many times, end up with processes that in other industries would be considered both technologically infeasible or economically unviable.

Like all systems, processes are subject to variation, which should be minimized to enhance performance (Holweg et al., 2018, Schmenner, 2015). Variation can be categorized as predictable or random. While predictable variation can be identified and managed, reducing random variation requires fundamental changes to the process (Deming, 1982, Holweg et al., 2018, Shewhart, 1932). Variation significantly impacts process throughput and work-in-process levels, which are determined by throughput rate and throughput time. This relationship is defined by Little's Law, see Figure 7, which highlights constraints inherent in every process and guides efforts to eliminate waste, thereby improving throughput (Schmenner, 2015, Little, 1961). Throughput reflects the actual performance of the process, productivity relates

throughput to input capacity needed to enable the throughput, and output capacity sets the upper limit on throughput.

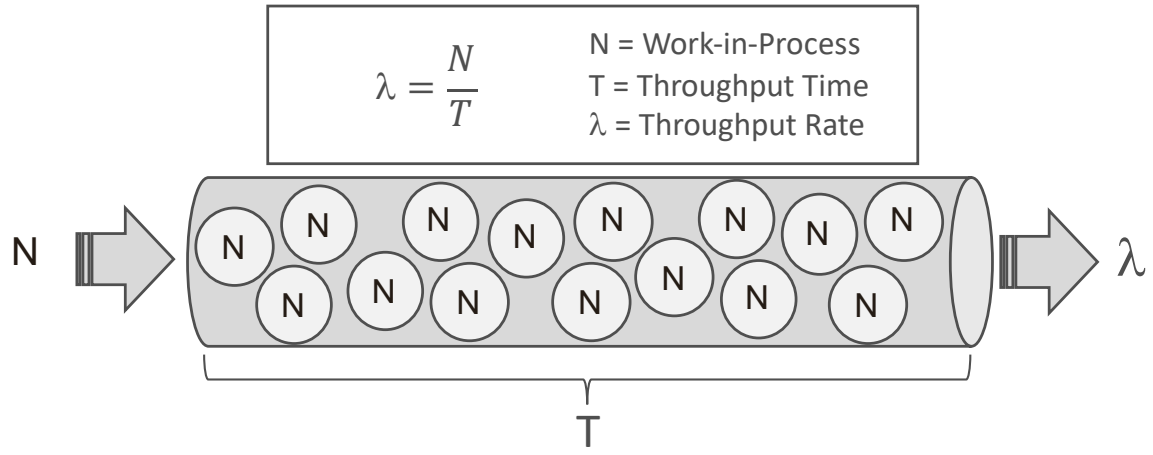

Figure 7: Visualization of Little's law

Kingman's formula extends Little's Law by establishing dependencies between waiting time, variation in demand, and input capacity utilization. It demonstrates that process variation limits the full utilization of available resources. When input capacity utilization approaches its maximum capacity, waiting times increase exponentially, see Figure 8 (Kingman, 1966). To ensure high throughput, it is therefore crucial to manage variation and maintain an optimal balance between resource utilization and process efficiency. Variation in healthcare processes significantly impacts capacity utilization and overall system efficiency (Sharma et al., 2021). Queueing theory has been applied to hospital capacity management to analyze these dynamics, revealing that high utilization rates, when combined with variability, can significantly increase waiting times. This insight emphasizes the importance of balancing utilization with the need to accommodate variability to maintain process efficiency (Walley et al., 2006). Studies show that healthcare systems experience excessive queues not primarily due to capacity shortages but also because of a lack of attention to demand variation and inappropriate responses to queues. The inherent unpredictability of patient arrivals and the variability in service times can also lead to increased waiting times and reduced service quality (Terwiesch et al., 2011).

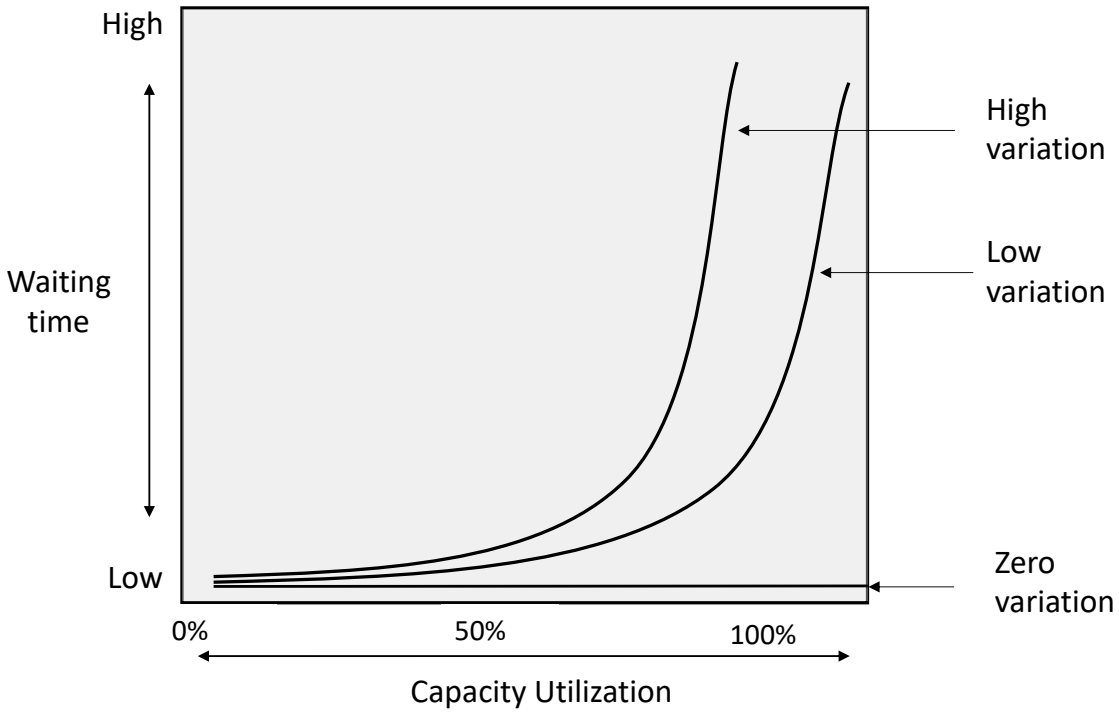

Figure 7: Visualization of Kingman's Formula

Another critical factor affecting process performance is the presence of bottlenecks, which dictate system throughput. Bottlenecks can be classified as stationary (consistent regardless of production schedules) or moving (fluctuating based on demand and scheduling) (Goldratt, 1994). Addressing bottlenecks caused by process anomalies requires reducing complexity, which is determined by the number of static elements, their heterogeneity, and their dynamic interactions. Complexity can be managed either by eliminating unnecessary features or by enhancing the system's ability to cope with them (Holweg et al., 2018, Simon, 1962). Furthermore, processes do not function in isolation, and optimizing individual components does not guarantee overall efficiency, highlighting the necessity of reducing bottlenecks and implementing process improvements that enhance system-wide performance. Achieving this requires alignment across an organization's strategic, tactical, and operational levels (Holweg et al., 2018, Lee et al., 1997, Schmenner, 2015). Finally, every process functions as a microcosm of the larger operational system to which it belongs, with transformed resources flowing between different process stages (Slack and Brandon-Jones, 2019). The transformation process occurs as inputs become work-in-process and progress through successive steps toward completion (Holweg et al., 2018). For a process to achieve efficiency and effectiveness, it must be integrated into a management system responsible for its operation, control, and continuous improvement. Feedback loops on process performance inform necessary adjustments (see Figure 9). Every industrial process operates within a management system, which serves as the foundation of OM.

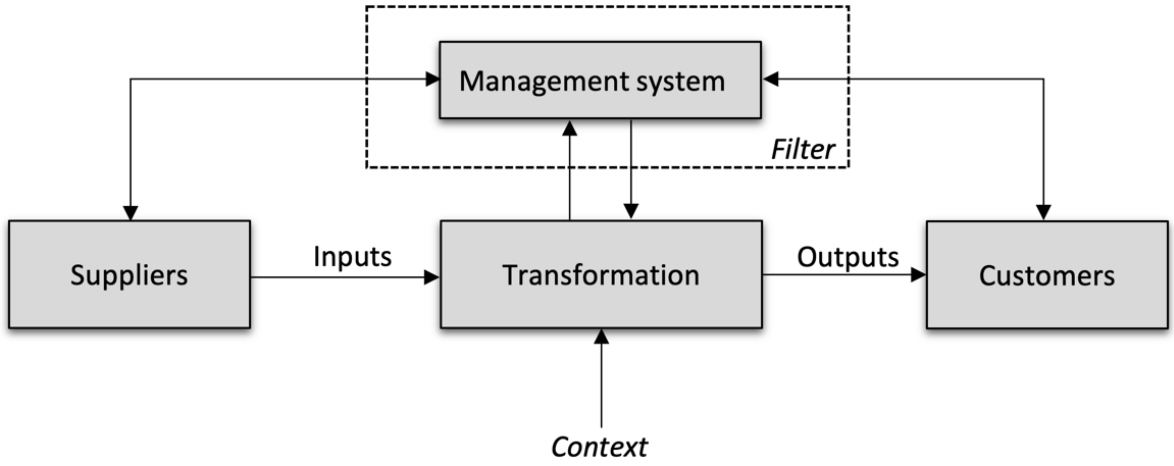

Figure 8: Process model with management system

2.4 Healthcare Operations Management

The field of Operations Management is concerned with designing and controlling the production of goods and services, ensuring that organizations are efficient in using resources to meet customer requirements. It is concerned with managing an entire production or service system that converts inputs into outputs (Chase, 2007, Slack and Brandon-Jones, 2019). When managing manufacturing or service operations, several types of decisions are made including operations strategy, product design, process design, quality management, capacity, facilities planning, production planning, and inventory control. OM generally considers all of these areas to analyze the current situation and find better solutions to improve the effectiveness and efficiency of manufacturing or service operations (Chase, 2007).

Healthcare Operations Management (HOM) is a sub-field within OM and is described by KC et al. (2020) as focused on 'the efficient allocation of critical resources, the design and organization of effective delivery systems, and the use of technology in enabling new innovative models of care delivery'. HOM shares with medical research an interest in improving patient outcomes. However, instead of the clinical outcome variables of medical research, it focuses mainly on operational and process variables, and instead of studying interventions as in medical research, it studies underlying mechanisms in the care process that affect or moderate its effectiveness (KC et al., 2020). Decisions in HOM often concern matching supply and demand and can be made at different levels of planning, operational, tactical, and strategic (Vissers et al., 2023). Vissers et al. (2023) have developed a hierarchical framework for the management and control in healthcare organizations, see Figure 9. Decisions to be made for matching supply and demand are organized at different levels, where decisions with a longer planning horizon are positioned at a higher level in the framework. As healthcare is politically governed in many healthcare systems, another layer has been added to the framework, tying the outcome of HOM to the decisions and aims of politicians.

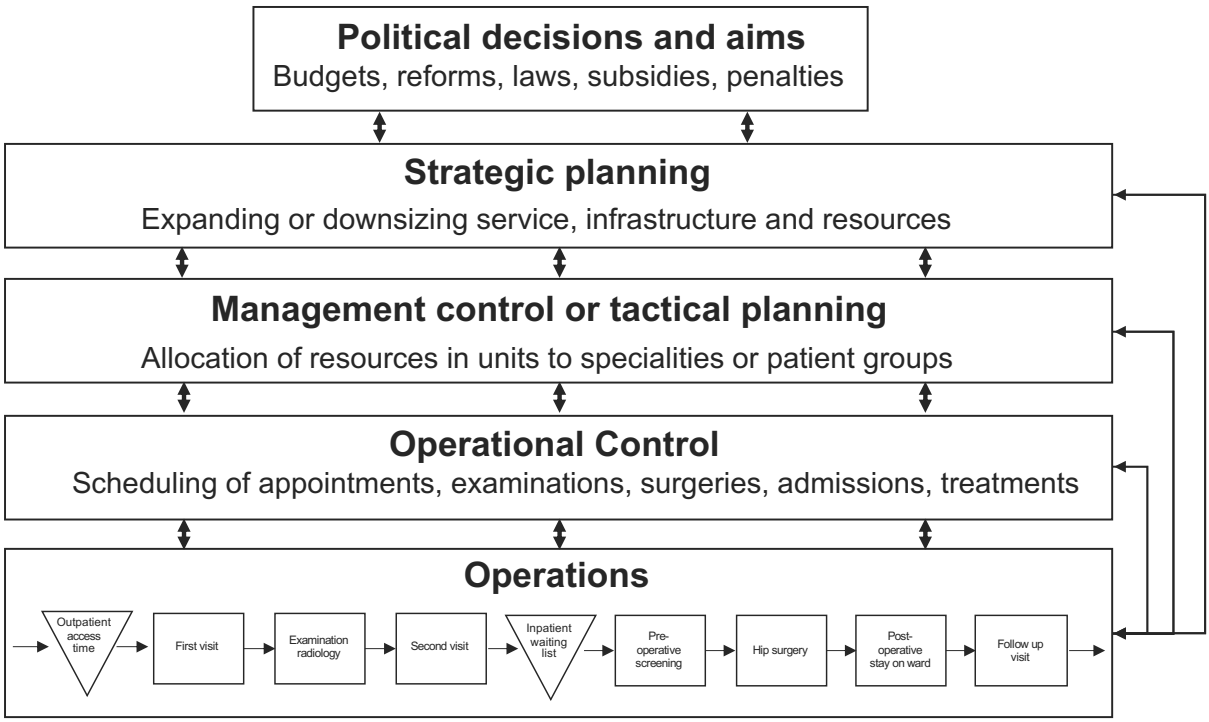

Figure 9: Framework for the management and control in healthcare organizations

2.5 Capacity and capacity utilization

Aligning and coordinating available supply or capacity with current and projected demand is a fundamental aspect of OM practices. This requires, however, a precise definition of the term "capacity". According to Slack and Brandon-Jones (2019), capacity refers to the maximum level of value-added activity that a process can achieve over a specific period under normal operating conditions. It is also describes as the capability of an individual worker, workstation, or production system to perform according to its intended function (ASCM, 2024). Measuring capacity can be approached from two perspectives: input capacity and output capacity. Input capacity refers to the available resources accessible to a process, such as staffing levels, floor area, machine hours, and time slots. Conversely, output capacity pertains to the volume of outputs produced over a given timeframe, such as the number of units manufactured per week in a factory, students graduating per year at a school, or passengers transported weekly by a ferry service. Slack and Brandon-Jones (2019) further categorize capacity into three distinct types: design capacity, effective capacity, and actual output. Design capacity is the theoretical maximum output capacity envisioned during the operation's design phase. Effective capacity represents the achievable capacity after accounting for planned losses, such as maintenance requirements and scheduling challenges that may reduce operational time. Actual output, the final category, reflects the capacity achieved after accounting for both planned and unplanned losses, including issues such as quality defects, equipment breakdowns, employee absenteeism, and other preventable disruptions. Moreover, capacity utilization is calculated by dividing

actual output by design capacity, while process efficiency is determined by dividing actual output by effective capacity.

An alternative framework is proposed by Vissers and Beech (2008) who classify capacity into five categories: potential, available, usable, utilized, and productive. Potential capacity is defined as the theoretical maximum capacity of a process if all possible resources are utilized as intended during the design phase. Available capacity, by contrast, refers to the portion of potential capacity designated for use after excluding non-available capacity. In healthcare, this distinction is evident when operating theaters are not utilized during evenings or weekends. Usable capacity represents the capacity remaining after deducting non-usable time, such as scheduled maintenance or time allocated for other essential activities. In healthcare, this may include reserved operating time or facilities designated for emergency surgeries. Utilized capacity, then, refers to the capacity actively employed in production, while productive capacity is reached once idle time and non-productive time are excluded. Idle time constitutes capacity lost due to canceled operations or unutilized time following the premature conclusion of activities. Non-productive time, though necessary, does not directly contribute to value creation; an example within healthcare would be the setup time between consecutive surgeries.

2.6 Healthcare performance and productivity

Productivity is commonly defined as the efficiency of production, which reflects the extent to which output is derived from a specified set of inputs (Syverson, 2011). It is typically quantified as an output-to-input ratio (Misterek et al., 1992, Syverson, 2011, Wacker, 2004). According to Slack and Brandon-Jones (2019), productivity represents the ratio between the outputs generated by an operation and the inputs required to achieve that output. While productivity can be measured in various ways, Schmenner and Swink (1998) argue that fully explaining productivity disparities between different facilities is challenging due to the multitude of inputs required to produce a specific output. These inputs are often employed to produce multiple outputs simultaneously. Additionally, each production process is influenced by a distinct set of conditions, including bottlenecks, scheduling efficiency, workforce organization, and variability in quality, demand, and operational methods (Schmenner and Swink, 1998, Slack and Brandon-Jones, 2019, Syverson, 2011). Consequently, productivity metrics often adopt a narrower focus, such as units produced per labor hour, machine hour, material expenditure, or combinations thereof (Schmenner and Swink, 1998). In the context of hospitals, the most commonly employed productivity measures are health services provided for a certain time frame, which include metrics such as performed surgeries, appointments and patient discharges per day or the average Length of Stay (LoS) for patients at a given time (Kämäräinen et al., 2016, McGlynn, 2008). Furthermore, diagnosis-related groups (DRGs) provides a point system for the grading of care complexity and are utilized to facilitate comparisons between hospitals with differing case mixes (Clement et al., 2008). Inputs are generally classified into financial and physical categories. Financial inputs predominantly encompass the costs associated with

healthcare services, including expenditures on labor and capital. Conversely, physical inputs are often categorized by factors such as numbers on staffing, physical beds, medical equipment, and the number of hours they are used (Linna et al., 2010). Productivity enhancement can be achieved through two primary approaches: increasing output using the same level of resources or maintaining output levels while reducing resource consumption. This thesis focuses on productivity improvement through the enhancement of output levels given the available resources. Specifically, the research aims to examine how the throughput of patients across hospitals can be increased and how existing capacity can be more effectively utilized to enhance improved patient flows across healthcare facilities.

2.7 Patient flow

Patient flow in hospitals is frequently conceptualized as process throughput, where the emphasis is placed on the speed with which patients are treated and subsequently discharged to enhance hospital productivity (Devaraj et al., 2013, Johnson et al., 2020, Roemeling et al., 2017). Bottlenecks within these patient flow processes, encompassing both administrative and clinical activities, can result in increased costs, diminished quality of care, and heightened risks of infection or medical complications for patients (Devaraj et al., 2013). Therefore, reducing process times and enhancing flow management throughout hospital systems is a critical objective. The primary metric of interest concerning patient flow in hospitals is LoS, defined as the total duration a patient remains in the hospital from admission to discharge. The LoS is influenced by numerous factors, including the patient's condition and procedural delays encountered throughout the discharge process (Johnson et al., 2020, McDermott and Stock, 2007). Thus, improving patient flow requires efforts to enhance process throughput by alleviating bottlenecks and minimizing internal variability through error reduction and consistency in outcomes (De Regge et al., 2019).

Researchers frequently highlight the issue of hospital overcrowding and its detrimental impact on patient flow (Davis et al., 2019, Improta et al., 2018). Overcrowding commonly occurs within Emergency Departments (EDs) when patients cannot be admitted and processed within a reasonable timeframe due to fully occupied inpatient beds, resulting in a 'blocking' effect that hinders patient transfers from the ED. This scenario may force patients to be allocated to inappropriate wards, where staff may lack familiarity with their conditions, thereby compromising the quality of care (Johnson et al., 2020, McDermott and Stock, 2007). Additionally, overcrowding arises when the number of patients admitted exceeds the available capacity of the hospital. This is particularly evident when patients are placed in overcapacity beds or in 'non-available' beds within inpatient wards, leading to capacity utilization rates exceeding 100% (Fidler et al., 2007, Goldman et al., 1968, Stjernstedt, 2016). Moreover, persistent overcrowding or high work-in-process levels place substantial stress on the healthcare

system, thereby extending throughput times or LoS and contributing to staff burnout (Davis et al., 2019, Improta et al., 2018). Consequently, effective management of bed capacity and LoS is essential to ensure efficient patient throughput and the provision of high-quality, safe healthcare (Devaraj et al., 2013, Johnson et al., 2020, Kreindler, 2017).

2.8 Theory of Swift and Even Flows

The Theory of Swift and Even Flow (TSEF), as defined by Schmenner and Swink (1998), integrates fundamental principles often referred to as the laws of OM (Seuring, 2009) or the five well-established production principles (Onofrei et al., 2020). These principles include:

1. **The Law of Variability:** Drawing on queuing theory, this principle suggests that greater variability within a process leads to reduced productivity (Conway et al., 1988, Kannan and Palocsay, 1999).

2. **The Law of Bottlenecks:** A process is only as efficient as its slowest stage, much like a chain is only as strong as its weakest link (Goldratt and Cox, 2014).

3. **The Law of Scientific Methods:** Highlights the effectiveness of applying scientific methods to work design on the shop floor (Box, 1994).

4. **The Law of Quality:** This principle posits that productivity improves when quality is enhanced, primarily through waste reduction (Deming, 1982, Gryna and Juran, 2001).

5. **The Law of Factory Focus:** Stresses that factories (production units) should focus on a limited set of tasks rather than spreading their efforts across a wide array of objectives (Pesch and Schroeder, 1996, Skinner, 1974).

According to Schmenner (2015), TSEF provides a framework for understanding why one service operation or manufacturing process is more productive than another by examining the relationship between inputs and outputs. The theory suggests that "the more swift and even the flow of materials through a process, the more productive that process is" (Schmenner and Swink, 1998). This applies to all types of productivity, including labor, machine, materials, and total factor productivity. According to Schmenner and Swink (1998), improving flow performance can be achieved by overcoming three barriers: bottlenecks, non-value-added activities (e.g. unnecessary waiting or unnecessary process steps), and variability associated with the flow. *First*, throughput time measures the duration from the point when materials are first processed until the final product is completed and ready for delivery or storage. Reducing throughput time helps isolate and eliminate bottlenecks or disruptions that hinder productivity. The theory emphasizes minimizing time spent during this phase to improve flow efficiency.

Second, all work is classified as either value-added or non-value-added. Value-added work transforms materials into a good product, while non-value-added work involves moving, inspecting, counting, or reworking materials. Non-value-added activities, including Shingo's seven wastes, overproduction, waiting, transportation, unnecessary processing, stocks, motion, and defects, should be reduced or eliminated to enhance flow (Hall, 1987, p. 26). Reducing wasteful steps allows materials to move more swiftly through a process. *Third,* To achieve an even flow, it is essential to reduce variability related to demand or the process itself. Variability is measured by examining the variance or standard deviation of timing, quantities demanded, or time spent on process steps. Lowering variability through steady, "level" production plans and grouping similar tasks enhances productivity by reducing inconsistencies in timing and demand.

2.9 The Focused Factory

The Focused Factory concept, introduced by Skinner (1974), is closely associated with the theories of TSEF, by emphasizing the need for operational focus to enhance productivity (Seuring, 2009). The Focused Factory concept proposes that companies attempting to excel simultaneously in cost, quality, speed, and flexibility will ultimately fall short in all areas (Dabhilkar and Bengtsson, 2011). Instead, firms should prioritize and focus their manufacturing efforts on a limited, well-defined set of objectives (Hyer et al., 2009). According to Skinner (1974), the most important characteristic of a focused factory is minimizing deviation in terms of process technologies, market demands, product volumes, quality levels, and manufacturing tasks. This approach enables companies to reduce complexity and excel by concentrating their resources on fewer tasks (Pieters et al., 2010).

The focused factory concept involves three primary strategies (Skinner, 1974):

1. Structuring production plants to focus on a concise and manageable set of products, technologies, volumes, and markets.

2. Developing production policies and services that align with a single, explicit objective rather than conflicting, implicit ones.

3. Considering the efficiency of the entire production organization rather than focusing solely on direct labor efficiency.

Cellular manufacturing, a within-plant application of the Focused Factory concept, seeks to streamline operations by grouping similar processes, resources, and tasks within operational cells. These cells are designed to improve efficiency by reducing variability and complexity (Hyer et al., 2009, Wikner et al., 2017). The historical origins of focus in operations can be traced back to Adam Smith's division of labor in The Wealth of Nations (1776), which illustrated the efficiency benefits of specialization. Skinner's work expanded this concept by

asserting that firms must make strategic trade-offs to achieve superior performance in prioritized objectives (Dabhilkar and Bengtsson, 2011, Skinner, 1974). The Focused Factory concept has significant implications for operations management, particularly in how organizations structure their manufacturing facilities and policies to enhance productivity by concentrating on a narrow set of objectives (Hyer et al., 2009). Hospitals look into the opportunities offered by concepts from business. One of these concepts is the so-called focused factory concept. Focus in healthcare operations is often employed in the debate about how the hospital industry can cut costs and concurrently meet the pressures of increased demand for health services (Dabhilkar and Svarts, 2019). Implementing "focused factories", aimed at specific treatments or diseases, is proposed as a way to increase the efficiency of hospital care (Bredenhoff et al., 2010). Over the past 25 years the focus principle has been reflected in a number of hospital improvement initiatives where specialty hospitals (e.g., heart hospitals) and ambulatory surgery centers are examples of focused factories in health care (Hyer et al., 2009).

3 Method

This chapter outlines the methodological approach of this thesis and describes the strategy employed to address the research questions. The methodology for each study is detailed, followed by a discussion on the limitations and the quality of the research.

3.1 Research approach and strategy

The research approach underpinning this thesis is abductive reasoning, characterized by an iterative interplay between inductive and deductive logic throughout the investigative process (Saunders, 2019, Langley and Tsoukas, 2013). Although the research was primarily driven by empirical inquiry, it consistently oscillated between empirical observations and theoretical insights. Abduction neither begins with fully predefined research questions and theoretical frameworks nor with a completely blank slate devoid of prior understanding (Langley and Tsoukas, 2013). Guided by the aims and objectives of the research project, a range of practical challenges emerged. These challenges sparked curiosity and prompted an exploration of how similar issues had been approached in existing literature, including which methodological tools could be employed for their analysis. This exploration informed the formulation of new research questions and shaped the study design. To interpret the empirical findings, the research drew on established theoretical frameworks from Operations Management and related disciplines. In this way, empirical data served as a catalyst for theory development (van Maanen et al., 2007). This dynamic and reciprocal process facilitated the theoretical structuring of data, the development of conceptual insights, and the systematic identification of research gaps (van Maanen et al., 2007).

The research strategy is motivated by the recognition that hospital-wide patient flow remains an underexplored phenomenon, with limited research adopting such a comprehensive perspective. To investigate this phenomenon, an exploratory and descriptive mixed-methods research strategy was employed, emphasizing qualitative research methods. Mixed-methods approaches, which integrate both qualitative and quantitative methods, provide a robust framework for enhancing the validity and reliability of findings (Bell et al., 2019, Saunders, 2019). This strategy is closely associated with triangulation, whereby findings from diverse studies are compared, leveraging the complementary strengths of qualitative and quantitative data to enhance generalizability (Bell et al., 2019). Moreover, integrating qualitative and quantitative approaches fosters creativity in uncovering novel or paradoxical aspects that may inspire further research. By combining these methods, a more comprehensive understanding of the research topic can be achieved (Esteves and Pastor, 2013). A mixed-methods approach is particularly valuable for addressing complex research questions, as it balances in-depth qualitative insights with the capacity of quantitative research to reveal broader trends (Clark and Ivankova, 2016, Guetterman et al., 2015). Additionally, a general emphasis on qualitative research is especially well-suited for exploring new phenomena, providing rich, nuanced explanations of what actors do, how they do it, and why they do it (Flick, 2014).

3.2 Research design

Unlike research projects bound by predetermined structures and designs, this research project has been allowed to evolve organically, driven by insights that emerged throughout the process. The project comprises five interrelated studies, conducted both sequentially and in parallel, as illustrated in Figure 10. The studies were strategically designed to explore and describe the phenomenon of hospital-wide patient flows from various perspectives, with each study contributing new insights that informed the ongoing research. The progression of the studies followed a logical sequence, beginning with problem identification, followed by the exploration of potential solutions and improvement strategies for how to facilitate and operationalize hospital-wide patient flows.

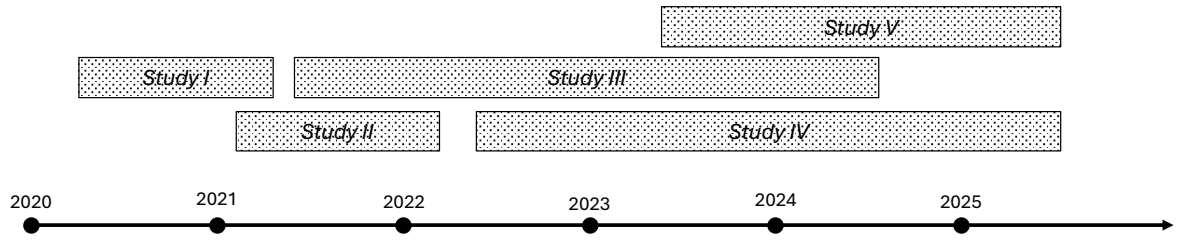

Figure 10: The timeline of the research project

Study I employed a systematic literature review methodology. A systematic literature review (SLR) is a research method that involves a comprehensive and structured synthesis of existing studies on a specific topic (Bell et al., 2019). It provides an exhaustive overview of relevant research, uncovers areas where evidence is lacking, thereby highlighting opportunities for future research, provides a solid foundation for informed decision-making, and is particularly valuable for developing a comprehensive understanding of a phenomenon and mapping its general patterns. As described by Booth et al. (2016), such reviews offer a "systematic, explicit, and reproducible method for identifying, evaluating, and synthesizing the existing body of completed and recorded work produced by researchers, scholars, and practitioners."

Study II and Study V were conducted as semi-structured interview studies. Choosing interviews as a research method allows for the collection of in-depth, qualitative data, providing rich insights into participants' experiences, perceptions, and attitudes. This method is particularly valuable when exploring complex phenomena that require a deep understanding of individual perspectives (Bell et al., 2019). Semi-structured interviews, in particular, offer a balance between structure and flexibility. They are guided by a set of predetermined questions, ensuring that key topics are covered, while also allowing interviewers the flexibility to explore emerging themes based on participants' responses. This approach facilitates a comprehensive exploration of the research subject, enabling participants to express their thoughts and experiences in their own words. The adaptability of semi-structured interviews enables researchers to tailor questions to the interview context, allowing for the exploration of new themes that may arise

during the conversation. This flexibility can lead to richer and more nuanced data, providing a deeper understanding of the research topic (Kvale, 2007).

Study III employed a single case study approach. Such an approach is appropriate when addressing "how" questions, unraveling complex phenomena (Yin and Campbell, 2018, Eisenhardt and Graebner, 2007), and building theory (Edmondson and McManus, 2007, Gioia et al., 2013). A single case study involves an in-depth, contextual analysis of a specific instance or phenomenon. This approach is also valuable when the case is unique, rare, or provides significant insights into a broader issue (Yin and Campbell, 2018). By focusing on a single subject, researchers can explore complex variables and their interrelationships within real-life contexts. According to Eisenhardt (1989), case studies provide empirical evidence essential for refining theory, while Yin and Campbell (2018) emphasize their value in generating rich insights into the contemporary dynamics of phenomena. Additionally, case studies are recommended for theory development or extension, as they yield valuable managerial knowledge (Gibbert, 2008, Voss et al., 2002). As Flyvbjerg (2022) notes, when little is known about a phenomenon, single case studies are particularly effective in providing a thorough understanding of specific problems within their contexts. Although statistical generalization is limited, a single case study is appropriate when examining under-researched phenomena (Ketokivi and Jokinen, 2006).

Study IV was conducted as a multiple-case study. A multiple-case study is a qualitative research method that involves the in-depth analysis of several cases within a particular context. This approach is particularly valuable when seeking to understand differences and similarities across cases, thereby enhancing the robustness of research findings (Yin and Campbell, 2018). Multiple cases allow researchers to identify patterns and variations, facilitating a deeper understanding of the phenomenon under study, and are well-suited for investigating mechanisms underlying the development of complex phenomena (Yin and Campbell, 2018). Multiple case studies can contribute to theory building by exploring how and why certain phenomena occur across different settings. This method allows for the identification of underlying principles that can inform theoretical frameworks (Voss et al., 2002). Furthermore, this approach facilitates triangulation by allowing data collection from various sources, thereby enhancing the potential for generating broader generalizations (Flick, 2014).

3.3 Data collection and analysis

The data collection relies on multiple sources: a systematic literature review, interview studies, observations, database statistics, and archival documents, see Figure 11, for an overview of the association between studies and selected methods of data collection and data analysis. For an overview of connections between studies, papers, research questions, and the purpose, see Figure 12.

Study		I	II	III	IV	V
Data collection	Systematic literature review	x		x		
	Interviews		x	x	x	x
	Observations			x	x	
	Data base statistics			x		
	Documents				x	
Data analysis	Thematic analysis	x	x	x	x	x
	Process mapping			x		
	Quantitative analysis	x		x	x	

Figure 11: Overview of the data collection

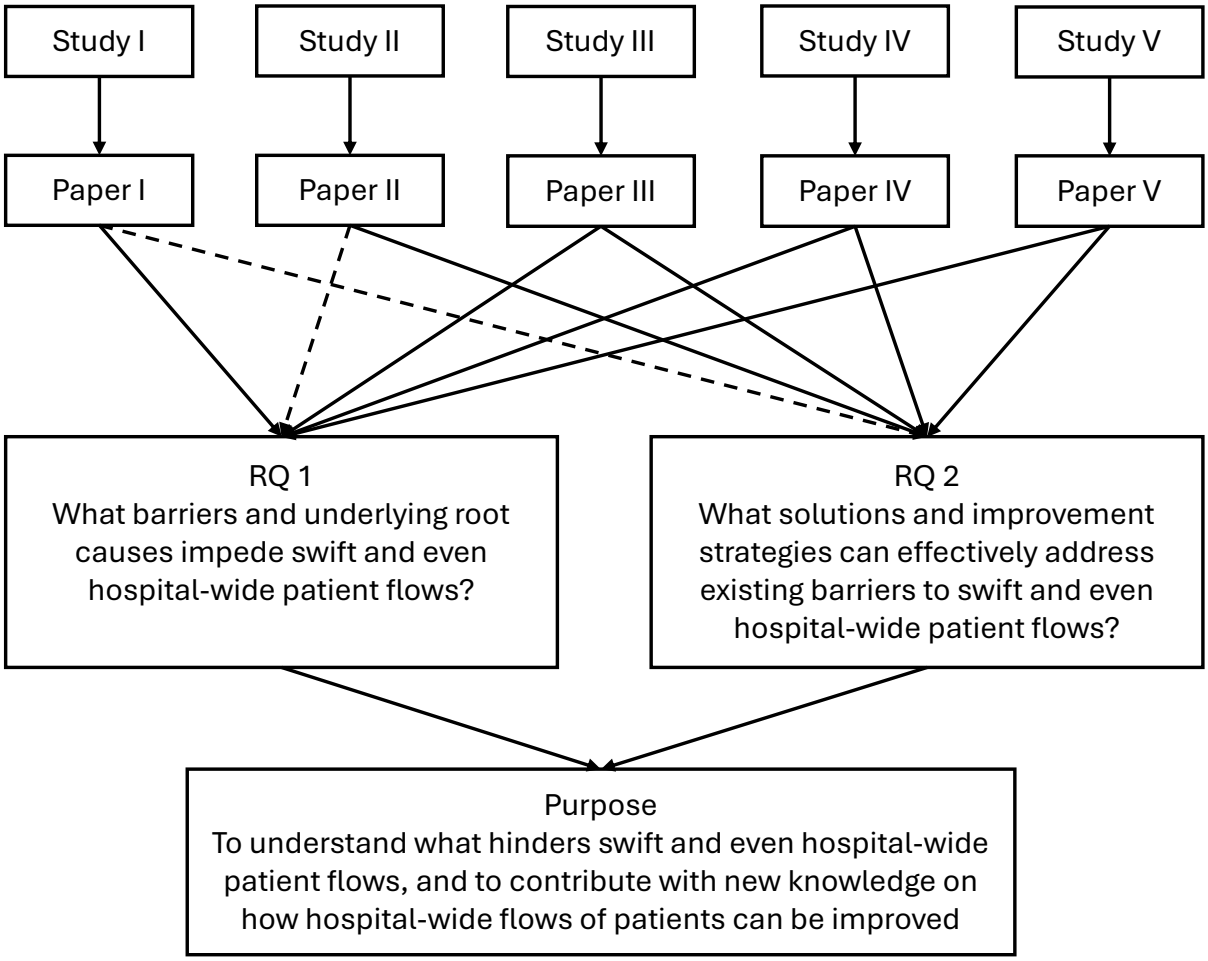

Figure 12: Connection between studies, papers, RQs, and purpose

3.3.1 Study I – A systematic literature review

Study I addresses both research questions of this thesis, however, mostly the first question, by investigating barriers to achieving efficient hospital-wide patient flows. Despite its significance, the challenge of ensuring swift and even patient throughput across hospitals remains poorly understood, with limited empirical research dedicated to this issue. Both in Sweden and internationally, opportunities for researchers to initiate or engage in hospital-wide patient flow

improvement projects are scarce. While a substantial body of literature exists focusing on dismantling process barriers and enhancing patient flow within specific hospital departments, research adopting a comprehensive, hospital-wide perspective remains conspicuously lacking. This gap underscores the necessity of systematically integrating these fragmented perspectives, which serves as the foundation of this study. The purpose of this article is twofold: (1) to explore existing research on factors hindering swift and even patient throughput in hospitals, and (2) to synthesize these factors into overarching themes, primary barriers, and underlying root causes.

Data collection and analysis

To address the study's objective, a systematic literature review was conducted following the methodology outlined in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement (Moher et al., 2009). Relevant studies were identified through searches of three major databases: PubMed, Scopus, and Web of Science. The search strategy employed both Medical Subject Headings (MeSH) terms and related free-text keywords to ensure a thorough compilation of pertinent articles. The screening process comprised two stages: an initial review of titles, keywords, and abstracts, followed by a detailed analysis of full-text articles, adhering to predefined inclusion and exclusion criteria. The selected articles underwent thematic synthesis methodology (Booth et al., 2016, Braun and Clarke, 2006, Dixon-Woods et al., 2004). Individual text segments were coded as "free codes," with each code signifying a distinct barrier to patient flow. To systematically organize the large number of identified barriers, tree diagrams were constructed, providing a hierarchical structure that illustrated both broader categories and specific root causes. This approach facilitated a comprehensive thematic analysis, enabling the identification of overarching themes, specific barriers, and underlying root causes. A hierarchy evolved based on the recurrence of both barriers and root causes. Furthermore, to build a hospital-wide perspective, barriers and root causes that previous articles had identified were categorized according to the medical settings in which they had been studied. The systematic literature review resulted in the development of a cohesive framework for understanding patient throughput barriers. This framework served as the basis for a subsequent study aimed at identifying potential solutions to the barriers and root causes uncovered during the initial research.

3.3.2 Study II – An international interview study

Study II addresses both research questions of this thesis, however, focusing more on the second one, by investigating solutions and improvement strategies for achieving efficient hospital-wide patient flow. Previous research on hospital-wide patient processes remains limited, particularly concerning solutions aimed at streamlining these processes. Although Gualandi et al. (2019) conducted a systematic literature review on solutions for efficient patient flows, their focus was primarily on addressing emergency departments and did not comprehensively address hospital-wide requirements. To explore solutions to the barriers identified in Study I, the research team decided to conduct interviews with practitioners directly. The objective was to gather best

practices from leading hospitals worldwide by interviewing top managers with extensive knowledge of hospital-wide patient processes. Hospitals are recognized as highly complex organizations, with academic hospitals representing the peak of complexity within the healthcare sector due to the substantial number, diversity, and complexity of patients they manage, alongside their extensive teaching and research responsibilities. Consequently, academic hospitals likely encounter more significant obstacles and challenges compared to other healthcare institutions when striving to enhance their processes. Additionally, external demands for high performance are considerable, as these hospitals receive substantial funding from governments and public institutions for their research and teaching programs. Therefore, their approaches to achieving efficient hospital-wide patient flow are not only of particular interest but also potentially applicable to a broader range of hospitals with less complex organizational structures. The purpose of this study was, therefore, twofold: (1) to identify effective solutions for achieving efficient patient flow across hospital organizations, and (2) to develop a framework to guide improvements in hospital-wide patient flow.

Data collection and analysis

A qualitative, exploratory study design was employed, utilizing in-depth semi-structured interviews as the primary data collection method, guided by a well-established interview framework (Bell et al., 2019, Dixon-Woods et al., 2004, Kvale, 2007). To enhance validity, a pilot study was conducted with three regional hospitals in Sweden. Each interview was transcribed verbatim and analyzed, leading to minor adjustments in the interview guide to optimize time allocation between questions and improve the formulation of follow-up inquiries. Following the pilot study, participants were selected based on the 2020 international hospital rankings by *Newsweek* (Cooper, 2021), which annually ranks hospitals and medical clinics worldwide according to expert recommendations (e.g., doctors, hospital managers, healthcare professionals), patient survey results, and key medical performance indicators. Invitations were sent to the 25 highest-ranked hospitals, of which 18 agreed to participate. Eligibility criteria for participants included senior managers with (i) responsibility for patient flow-related issues and (ii) oversight of hospital operations, or substantial portions thereof. Consequently, participants held various roles, including CEOs, presidents, chief operating officers, hospital medical directors, and, in some cases, flow department managers. In total, 33 senior managers were interviewed.

All interviews were recorded, transcribed verbatim, and subsequently returned to participants for approval. The transcripts were analyzed using a thematic synthesis approach (Booth et al., 2016, Dixon-Woods et al., 2004). Open coding was applied to capture all expressed opinions and recommendations, facilitating the broad identification of distinct themes. Each identified "solution" was mapped to the corresponding barrier it aimed to address, resulting in a comprehensive collection of opinions and recommendations linked to at least one barrier from the framework developed in Study I. The open codes representing solutions, often associated

with multiple barriers, were collaboratively reviewed and aggregated into overarching themes by all three researchers. This process yielded 558 distinct opinions and recommendations, culminating in 50 unique solutions categorized under eight overarching themes. The second study not only utilized but also expanded upon the framework established in the first study, presenting an integrated model comprising barriers, root causes, and solutions aimed at enhancing patient flow efficiency across hospital systems. By building upon the identification of barriers from Study I, this study contributed practical solutions to the comprehensive framework.

3.3.3 Study III – A single case study

Study III addresses both research questions of this thesis by examining how improved productivity in full-service hospitals can be achieved through enhanced operational focus. Previous research suggests that hospital productivity may be improved by increasing operational focus, which involves separating complex processes from simpler ones. While much of the healthcare research has concentrated on specialized facilities serving homogeneous patient groups (Pieters et al., 2010, Kc and Terwiesch, 2011), less attention has been directed toward full-service hospitals that manage diverse patient populations and complex care processes (Thirumalai and Devaraj, 2024). During the execution of Study II, it also became evident that general full-service hospitals encounter significant challenges in delivering efficient care to large, homogenous patient groups while concurrently managing the needs of smaller, more complex, and heterogeneous populations. Therefore, the objective of this study was to explore how operational focus can be applied to improve productivity in full-service healthcare organizations, given their inherent patient complexity. Due to the limited empirical research on the application of operational focus within full-service healthcare settings, this study employed an exploratory mixed-methods single case study approach. The study was conducted in three sequential stages: First, a systematic literature review was performed to investigate prior applications of the Focused Factory concept in healthcare, providing foundational insights for the single case study. Second, a single case study was conducted at a medical clinic to examine how patient processes are organized concerning patient volume and variation. Finally, the findings from the literature review were integrated with those from the case study to assess how existing knowledge on achieving operational focus in specialized facilities could be adapted to enhance operational focus in full-service healthcare providers. The aim of this study was threefold: (1) to explore how the Focused Factory concept has been applied in healthcare to achieve operational focus, (2) to examine the current state of operational focus within a traditional full-service healthcare provider, and (3) to investigate how the Focused Factory concept can be adapted to enhance operational focus in full-service providers.

Data collection and analysis

The systematic literature review was conducted following the methodology outlined in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement

(Moher et al., 2009). Relevant studies were identified through three major databases: PubMed, Scopus, and Web of Science. The search process utilized both Medical Subject Headings (MeSH) terms and related free-text keywords to ensure a comprehensive collection of relevant articles. Two screening rounds were performed: an initial review of titles, keywords, and abstracts, followed by a full-text analysis based on predefined inclusion and exclusion criteria. The selected articles were then analyzed using thematic synthesis methodology (Booth et al., 2016, Dixon-Woods et al., 2004). Each article was coded to capture all perspectives on the application and implementation of the Focused Factory concept, generating a list of relevant aspects. Similar codes were systematically analyzed, discussed, and consolidated until only unique categories remained, resulting in a final list of distinct aspects. This process produced a framework for Focused Healthcare Operations, demonstrating that focus in hospitals and medical clinics can be achieved through three steps: defining a strategic focus, evaluating operational focus, and implementing focus.

Following the principles of theoretical sampling (Eisenhardt and Graebner, 2007), a representative full-service Ear, Nose, and Throat (ENT) clinic within a major Northern European hospital was selected. It delivers inpatient and outpatient care, surgeries, diagnostics, therapy, and counselling, for both acute and chronic cases, capturing the operational complexity typical of full-service providers. Moreover, recently, the clinic had grappled with escalating costs, missed surgery and appointment targets, and a deteriorating work climate. The case study followed two main steps. Step 1 focused on mapping the clinic's main patient processes and their key clinical activities from defined start to endpoints, including transitions between processes. Mapping occurred in three stages. First, three researchers collaborated with two clinicians, the chief medical officer, and a team leader across four workshops to define and visualize 25 distinct processes: 19 outpatient, 1 emergency, and 4 surgical, based on patient groups and resource use. Second, team leaders reviewed these maps, suggesting refinements to process elements without altering the overall structure. Finally, a workshop with the full management team reviewed the care maps, identifying overlaps and prompting valuable discussions that led to minor revisions. Step 1 data collection took place from November 2021 to March 2022. Step 2 focused on analyzing patient volume and variation across the clinic's 25 processes, aiming to understand the complexity and operational characteristics of each process. Data collected included "time and date of visit," "diagnostic code," "surgical code" (if applicable), "type of treatment or intervention," "care profession," and "physical location." Visits were mapped to patient processes, and unclear cases were adjudicated by the Chief Medical Officer. Process leaders then validated each diagnosis list, producing a clean dataset. Combined with process maps, the data revealed every process's structure, patient count, and diagnostic mix. Data extraction ran from October 2022 to January 2023.

The developed Focused Healthcare Operations framework was then applied to the ENT clinic to assess its strategic focus. Subsequently, operational focus within each of the 25 patient processes was evaluated based on the care maps and the patient visit data. Each process was

assessed for product (patient) focus and process focus. Using the care maps and patient data, the various categories for evaluation of operational focus, presented in the framework, were measured and ranked in descending order from high to low focus. These categories were then divided into process focus and patient focus, and average focus scores were calculated for each. A total focus score was determined by averaging all categories, enabling comparison between product focus and process focus for each of the ENT clinic's patient processes. This methodology facilitated the analysis of how well the design of patient processes aligns with the variation, needs, and complexity of the patients treated within each process.

3.3.4 Study IV – A multiple case study

Study IV addresses both research questions of this thesis by examining how hospital-wide patient flow is operationalized, focusing on decision-making processes, their timing, location, and the individuals responsible for hospital-wide patient flow progression throughout the day and week. Study II identified a wide range of solutions aimed at improving hospital-wide patient flow. However, it also highlighted the need for a more in-depth exploration of how efficient patient flow is practically achieved and sustained in day-to-day operations. Therefore, given the limited knowledge in this area, an exploratory case study approach was adopted, following the recommendations of Eisenhardt (1989) and Yin and Campbell (2018) for investigating complex and poorly understood phenomena. This methodology is particularly suited for addressing "why" and "how" questions (Yin and Campbell, 2018) and, despite its relevance, has been described as underutilized in operations management research (Voss et al., 2002). To strengthen the robustness and external validity of the findings, a multiple-case study design was employed, as evidence from multiple cases is generally more compelling and reliable (Voss et al., 2002, Yin and Campbell, 2018). Theoretical sampling (Eisenhardt and Graebner, 2007) guided the selection of leading academic hospitals, chosen for their high complexity due to extensive patient variety, volume, and research and teaching responsibilities. These institutions face greater challenges in improving processes compared to other healthcare organizations, but typically demonstrate superior medical performance, likely supported by advanced flow logistics practices (Improta et al., 2018, Jha et al., 2005, Lovett et al., 2016a). As they receive substantial governmental and public funding for research and education, their efficiency practices may offer insights applicable to less complex hospitals. The identification of leading hospitals was based on the 2020 international hospital ranking by *Newsweek* (Cooper, 2021), which assesses hospitals worldwide based on expert recommendations, patient surveys, and key medical performance indicators. Following the approach of Stuart et al. (2002), five hospitals were selected for diversity, representing different healthcare systems in the US and Europe. Invitations were sent to the 15 highest-ranked hospitals, resulting in the participation of five hospitals, three American and two European.

Data collection and analysis

In all cases, in-depth semi-structured interviews served as the primary data source, supplemented by on-site observations and archival document analysis. Interviews followed a structured protocol to ensure cross-case comparability while allowing for emergent insights (Kvale, 2007). At each hospital, a Main Contact Person (MCP), ranging from vice presidents to patient flow managers, was appointed. The purpose of the study was presented to the MCP, with whom a customized data collection plan was developed. The process followed a consistent structure: pre-visit interviews, a one-week on-site visit, and follow-up interviews as needed. Prior to each visit, the MCP identified 4–6 key individuals involved in daily patient flow management for initial interviews. Together, these informed the design of the on-site visit, finalized in consultation with the MCP. Each hospital was then visited for one full work week, during which 20–29 interviews were conducted, primarily with managers but also including some non-managerial healthcare professionals. Interviews and observations focused on areas critical to patient flow, such as emergency departments, operating theatres, inpatient wards, ICUs, radiology, outpatient centers, and coordination hubs. A majority of interviews and visits to various parts of the hospitals were planned and booked before visiting, but following recommendations received during on-site interviews, more interviews and visits were made, following a snowball technique. Extensive notes were taken during the interviews and during all visits to the various parts of the hospital. Pre-visit interviews were conducted between April 24, 2022, and February 3, 2023, and on-site visits and follow-ups took place from February 13 to June 29, 2023. All data collection, including interviews, observations, and the collection of archival documents, was conducted by one author.

All interviews were recorded, transcribed verbatim, reviewed by all authors for familiarity with the data, and then analyzed using a thematic synthesis approach (Dixon-Woods et al., 2004, Braun and Clarke, 2006). One author conducted an open coding of both interviews and observations for each of the five cases, identifying 2,615 unique coded segments. The coded segments were then tagged with 2–3 keywords each, resulting in 450 unique keywords, allowing for multiple thematic connections and easier retrieval. The study focused on understanding how hospitals manage patient flows, who makes decisions, where, and how. Keywords related to "decision-making," "mandates," "responsibility," and "management" were specifically targeted.

As a result, between 70 and 90 relevant decisions concerning patient flow progression were identified for each case. The aim was to categorize where along the care trajectory these decisions occurred, in accordance with the patient flow barrier themes –"entry," "internal," "transfer," and "discharge" – as proposed in Paper I. Additionally, the organizational level (local vs. central) and the level of patient granularity (detailed vs. aggregated) were classified based on the framework by Vissers et al. (2023). Decisions were categorized as follows:

"Entry": Decisions concerning patient arrival or hospital admission.

"Internal": Decisions related to activities within specific clinics or units.

"Transfer": Decisions involving transfers between internal clinics or units.

"Discharge": Decisions concerning the discharge of patients from the hospital.

Decisions were further classified as central if made at the organizational level or with system-wide considerations, and as local if made at the departmental or unit level. In terms of granularity, decisions were coded as detailed if related to individual patients and as aggregated if concerning groups of patients. For each hospital case and each patient flow barrier theme, decisions were analyzed across the four resulting categories: (1) central-detailed, (2) central-aggregated, (3) local-detailed, and (4) local-aggregated. The proportion of decisions in each category was then calculated and presented in percentage brackets (0%, >0%–20%, 21–40%, 41–60%, 61–80%, 81–100%) to provide a quantitative overview of decision-making distribution across hospitals and flow barriers. Finally, to support the case analysis and offer explanations for the observed decision-making patterns, interviews, observations, and internal documents were used to provide case-specific contextual insights.

3.3.5 Study V – A multi-site interview study

Study V addresses both research questions of this thesis by exploring how first-line healthcare professionals without managerial responsibilities perceive patient flows from a system-wide perspective and to understand their strategies on how to improve the flow across their organizations. This study uses an exploratory qualitative approach, combining a deductive framework from previous research with an inductive perspective to capture healthcare professionals' subjective experiences. Building on the hospital-wide patient flow framework developed in study II, this study uses this as a guide while allowing new insights to emerge. A thematic analysis, following Braun and Clarke's (2006) approach, was conducted to identify key themes that align with and extend beyond the predefined framework, providing an in-depth understanding of factors that influence patient flow from the frontline perspective.

Data collection and analysis

Semi-structured interviews were conducted as the primary data collection method, using an interview guide to ensure consistency while allowing participants flexibility to share their views (Kvale, 2007). The guide focused on exploring barriers and enablers to hospital-wide patient flow, incorporating themes from prior research while remaining open to new insights. Hospitals were selected through purposeful sampling to include a diverse representation of healthcare professionals from both tertiary and secondary care settings. Three secondary care (services provided by medical specialists, often at hospitals, who in general do not have the first contact with patients) and three tertiary care (highly specialized care delivered in a hospital or similar care setting) hospitals participated. Initial contact was made with hospital directors, who then enabled a connection with relevant department managers, who then facilitated access to eligible

participants, physicians, and nurses in emergency, surgical, and inpatient care settings. Each hospital contributed five participants, one or two from each setting. In total, 30 interviews were conducted with no withdrawals. Interviews lasted 55 to 70 minutes, following a semi-structured format to allow in-depth exploration of participants' perspectives.

Extensive notes were taken during the interviews, and potential themes were identified, following a thematic synthesis methodology (Braun and Clarke, 2006, Dixon-Woods et al., 2004). Open coding of verbatim transcripts was conducted to capture all perspectives on factors that hinder or support hospital-wide patient flow, with each code categorized as either a barrier or an enabler. The coding followed an iterative process, allowing themes to be refined and patterns to emerge, ensuring the analysis was grounded in the data rather than predefined frameworks. Codes were then aggregated into broader themes at higher levels of abstraction. A key finding, in the final analysis, was the presence of paradoxes: healthcare professionals consistently described ideal visions for care that contrasted sharply with their real-world experiences, revealing a disconnect between organizational values and actual practice. Consequently, during data analysis, the focus shifted to exploring paradoxes using Smith and Lewis's (2011) dynamic organizing model, see Figure 13.

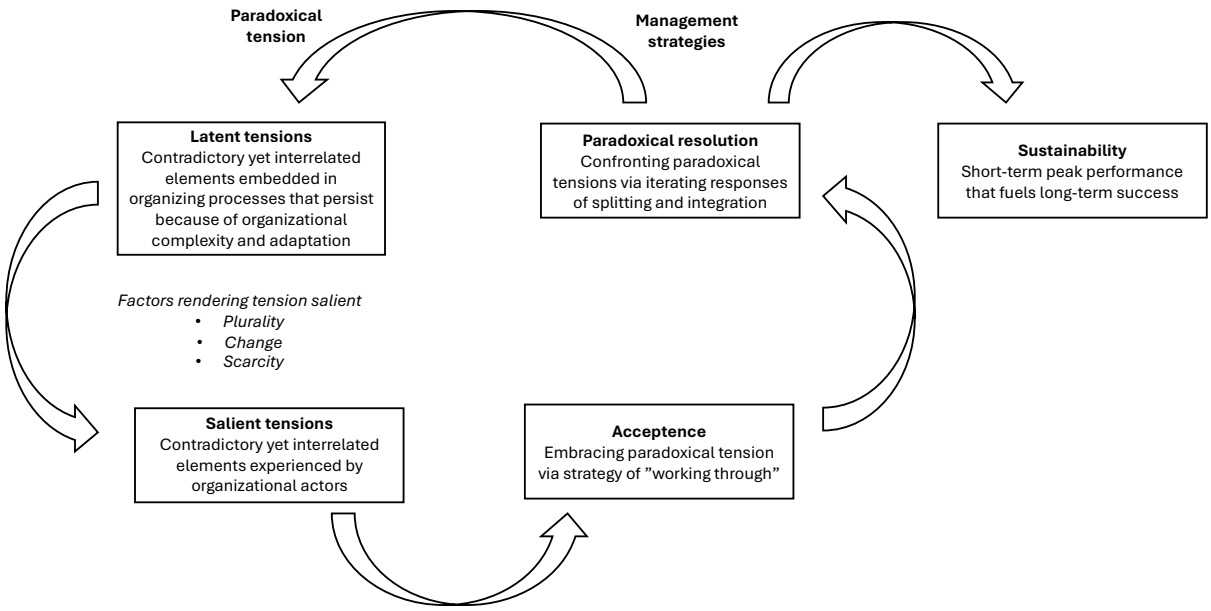

Figure 13: The dynamic organizing model of paradoxes

The model highlights several key points. First, paradoxical tensions within organizations can exist in both latent and salient forms. Second, responses to these tensions involve cycling through various management approaches. Third, these approaches influence organizational sustainability. While tensions may persist unnoticed within organizational structures, they become salient when triggered by external conditions or cognitive efforts that expose their contradictory and interconnected nature. Once surfaced, these tensions are experienced more directly by organizational members. Smith and Lewis (2011) argue that three environmental

factors: plurality, change, and scarcity, catalyze the shift from latent to salient tensions. Plurality, the coexistence of diverse perspectives in decentralized environments, heightens uncertainty and reveals conflicting goals and misaligned processes. Change introduces new opportunities for sensemaking as individuals reconcile short- and long-term priorities, along with competing yet interdependent roles and emotions. Scarcity, whether of time, money, or personnel, intensifies the trade-offs leaders face, forcing choices between interlinked alternatives. Together, plurality, change, and scarcity strain organizational systems and challenge rational decision-making. As a result, individuals may oversimplify tensions into binary choices, obscuring their underlying interdependence.

As paradoxes emerged as the dataset's most revealing feature, drawing on Smith and Lewis's (2011) dynamic paradox model seemed reasonable. The analysis concentrated on two stages: "Emergence and recognition of paradoxical tensions" and "Strategies for resolving those tensions". The model's middle stage, concerning the cyclical shifts in responses, was deliberately omitted as the goal was to pinpoint current barriers and the best ways to overcome them, not to chart long-term managerial cycles. Accordingly, the paradoxical tensions within the previously identified barrier themes were identified, along with the factors that made them salient. Finally, since healthcare professionals had proposed solutions to patient flow barriers highlighted throughout the interviews, paradoxical or not, their paradox-related resolutions were also identified.

3.4 Research quality and limitations

To assess the trustworthiness of this research, I applied the criteria outlined by Bell et al. (2019) for qualitative studies: credibility, transferability, dependability, and confirmability.

3.4.1 Credibility

Credibility in research quality refers to the confidence that the findings of a study are accurate, trustworthy, and believable from the perspective of the participants and the context of the research. It is particularly emphasized in qualitative research, but is relevant to all research methodologies (Bell et al., 2019). Credibility ensures the reliability of findings through methodical rigor. It is a criterion understood as a "value of the truth" (Halldorsson and Aastrup, 2003). Erlandson et al. (1993) stated that the credibility of research depends on how a researcher has attempted to increase the objectivity of the presented evidence due to limitations caused by his or her own construction of reality. Halldorsson and Aastrup (2003) also emphasize that no single reality exists, and researchers must be aware of their own constructions.

Study I	The systematic literature review in Study I followed the standard review procedure outlined by the Preferred Reporting Items for Systematic Reviews

	and Meta-Analyses (PRISMA) statement (Moher et al., 2009). The database search was conducted across three major databases, applying well-defined inclusion and exclusion criteria to ensure a comprehensive and relevant selection of papers. Finally, a rigorous thematization process, as recommended by Dixon-Woods et al. (2004), was meticulously followed and clearly documented.
Study II	Participants in Study II were selected based on a widely recognized hospital ranking, after which interviews were conducted with 33 managers across 18 hospitals using a structured interview guide. To enhance the study's credibility, a pilot study involving three regional hospitals in Sweden was first conducted. Subsequently, each interview was transcribed verbatim and analyzed collaboratively by all three researchers. Following the recommendations of Bell et al. (2019), respondent validation was implemented, allowing participants to review their statements and confirm the accuracy and appropriateness of the quoted material.
Study III	A comprehensive case study was conducted at a representative full-service medical clinic over a period of one and a half years. During this time, extensive data was collected, analyzed, and validated through workshops involving clinicians, thereby establishing a reliable data source. Additionally, a systematic literature review was conducted as a preliminary step, adhering to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines established by Moher et al. (2009).
Study IV	In this study, five large hospitals participated in a multiple case study designed to ensure credible and objective responses to the research questions. The hospitals were selected based on a widely recognized hospital ranking, with interviews conducted involving 20 to 29 individuals per hospital. To ensure consistency and optimal design across all case visits, a comprehensive pre-study was carried out, covering all parts of the hospital organization. While interviews were conducted, transcribed, and coded by a single researcher, all researchers participated collaboratively in the thematization of the data. Following the recommendations of Bell et al. (2019), respondent validation was implemented, allowing participants to review their statements and confirm the accuracy and appropriateness of the quoted material.
Study V	In this interview study, 30 healthcare professionals participated across six hospitals, providing a comprehensive and robust assessment of the research questions. The hospitals were selected to ensure representation from both tertiary and secondary care providers. Healthcare professionals from all areas

	of the hospital organization were then interviewed. Following the recommendations of Bell et al. (2019), respondent validation was implemented, allowing participants to review their statements and confirm the accuracy and appropriateness of the quoted material.

3.4.2 Transferability

Transferrability in research quality refers to the extent to which the findings of a study can be applied to other contexts, settings, or populations. The main aspects to consider are the contextual richness (allowing others to assess whether the findings are applicable to their own settings), sampling (diversity of participants and settings in the study influences how widely the findings can be transferred) reflexivity (researcher's awareness of their influence on the research process and outcomes), and data comparison analysis (connections between the study's findings and existing research) (Bell et al., 2019).

Study I	The presented framework is based on a systemetic literature review and with a comprehensive number of included articles. Consequenly, the results is likely transferable to any other hospital context and potentially to other healthcare settings. Furthermore, the methodology of developing a framework with a systems-based perspective, grounded in research that examines only parts of a system, can be applied to a broader range of contexts, including those outside of healthcare.
Study II	The complete framework presented in this study relies on both the results from the systemicatic literature reivew from study I, and a comprehesive interview study with senior managers at 18 of the world's 25 leading hospitals. Consequently, it is likley transferable to most other healthcare contexts. Additionally, the framework elements of a higher level of abstraction are likely transferable to other contexts and industries, particularly when used for comparing organizations within the same or different contexts, or as a theoretical framework for evaluating flow efficiency from a systems perspective.
Study III	The framework for Focused Healthcare Operations is based on research from a variety of healthcare contexts, making it likely transferable to most healthcare organizations. However, the results from applying the framework to the case study are less transferable, as only one case was examined. Nevertheless, the medical clinic was carefully selected to resemble a full-service hospital, thereby enhancing the relevance of our findings to other full-service healthcare organizations.

Study IV	This study is based on rich in depth case data from five different hospitals from three different countries with different healthcare systems. Each case has been explored thoroughly through on-site visits and an extensive number of participants representing each part of the hospital organization. Consequently, results may likely be transferable to most other hospital contexts and may also be applicable to other healthcare settings. The theoretical frameworks presented may also be transferrable to a broader range of contexts, including those outside of healthcare.
Study V	This study is based on a wide number of interviewed healthcare professionals from six different hospitals. Participants have also been selected to represent a large part of the central settings and functions of a hospital. Consequenly, results may likely be transferable to most other hospital context and may also be applicable to other healthcare settings.

3.4.3 Dependability

When considering dependability in research quality, several key aspects ensure the reliability and trustworthiness of the findings (Bell et al., 2019). Dependability requires that the research process and findings are consistent over time and across different contexts. It is also about documenting and making available the research methodology, data collection processes, analysis techniques, and any assumptions made, ensuring that others can follow and assess the research (Bell et al., 2019). Dependability is also enhanced when research data and processes can be followed in retrospect. This means there should be a clear record of how decisions were made throughout the research process, such as the selection of methods, data, and analysis choices. It relates to the "audit trail" of the conducted research (Guba and Lincoln, 1994) and emphasizes the importance of being able to track the research process and decisions made.

Study I	The methodology and rationale behind the decisions are clearly outlined in the paper. In the literature review, articles were meticulously selected, coded, and archived in accordance with the protocols outlined by Moher et al. (2009). Additionally, the process of thematization is thoroughly described, highlighting key decisions and challenges encountered along the way. The article selection strategy, along with all article codes and themes, has been carefully archived in cloud storage for easy retrieval if needed.
Study II	The methodology in the paper is clearly described, with motivations provided for all key decisions. The interview guide is also included, along with the dates of each interview, both for the main study and the pre-study. All interview

	codes, themes, and relevant participant quotes have been carefully archived in cloud storage for easy retrieval if needed.
Study III	The paper provides a thorough description of the case and review, with transparent explanations of the methods and decisions made throughout the research process. The article selection strategy for the review, along with the coding and thematization of the remaining articles, has been archived in cloud storage for easy retrieval if needed. This also applies to the numerous process maps and the anonymized patient data analyses.
Study IV	The methodology in the paper is clearly described, with motivations provided for all key decisions. The interview guide used is also available, along with the dates of each interview, both for the pre-study and the on-site visits. All observations, documents, and interviews, along with their associated codes, themes, and relevant participant quotes, have been carefully archived in cloud storage for easy retrieval if needed.
Study V	The methodology in the paper is clearly described, with motivations provided for all key decisions. The interview guide used is also available, along with the dates of each interview. All interviews, along with their associated codes, themes, and relevant participant quotes, have been carefully archived in cloud storage for easy retrieval if needed.

3.4.4 Confirmability

Confirmability in research quality refers to the degree to which the findings of a study can be verified or corroborated by others, ensuring that the results are not biased or influenced by the researcher's personal views. It is an essential aspect of ensuring research credibility and trustworthiness (Bell et al., 2019). Confirmability demonstrates researcher objectivity and acknowledges potential biases and concerns limitations affecting the research process and findings (Halldorsson and Aastrup, 2003). It provides a reflection of the researcher's values and standpoints in relation to the research (Bell et al., 2019).

Study I	A rigorous methodological process was followed, adhering to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines by Moher et al. (2009). Articles were independently screened by two researchers, while a third researcher contributed a fresh perspective during the thematization process. However, one limitation is that all authors share the same disciplinary background, which may have reinforced prior assumptions.

Study II	The research questions and interview guide were developed based on the findings from the systematic literature review conducted in Paper I, minimizing the risk of subjective values and biases in the research design. While the interviews were conducted by a single researcher, which could introduce subjective bias, the analysis and thematization of all interviews were carried out by all three researchers, helping to mitigate this risk. Following the recommendations of Bell et al. (2019), respondent validation was implemented, allowing participants to review their statements and confirm the accuracy and appropriateness of the quoted material.
Study III	The single case study was conducted as a well-defined collaborative project with the participating clinic. Process maps and patient data analyses were shared and continuously validated by the clinicians. For the systematic literature review, a rigorous methodological process was followed, adhering to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines by Moher et al. (2009). Articles were read and discussed by all researchers, reducing the risk of bias.
Study IV	The research questions and interview guide were developed based on the results from Papers I and II, minimizing the risk of subjective values and biases in the research design. The case visits, interviews, and observations were conducted by a single researcher, which introduced the potential for subjective bias. However, the analysis and thematization of all interviews were carried out by all three researchers, helping to mitigate this risk. One limitation, of course, is that all authors share the same disciplinary background, which may have reinforced prior assumptions. Following the recommendations of Bell et al. (2019), respondent validation was implemented, allowing participants to review their statements and confirm the accuracy and appropriateness of the quoted material.
Study V	One of the greatest limitations of the study is that it was designed, and the interviews, thematization, and analysis of the results were all conducted by a single researcher. However, following the recommendations of Bell et al. (2019), respondent validation was implemented, allowing participants to review their statements and confirm the accuracy and appropriateness of the quoted material.

3.5 Ethical considerations

This research aimed to explore how to improve patient flow in healthcare settings through a combination of qualitative and quantitative methods, including interviews, observations, and

patient data collection. Ethical considerations played a crucial role throughout the research process, ensuring the protection and privacy of participants and the integrity of the research. For two studies, applications were submitted to the Swedish Ethical Review Authority, which responded that no approval was required since no sensitive data was involved. Before participating in a study, all individuals in each study were fully informed about the research's purpose, scope, and potential risks. Clear and transparent communication was provided to all participants, ensuring that they understood their involvement in interviews, observations, and data collection. Participation was entirely voluntary, and participants were informed that they could withdraw at any stage of the studies without any negative consequences. To ensure participant privacy, all identifying information was kept confidential. Participants were given the option to remain anonymous throughout the studies. In cases where individuals requested anonymity, their identities were not disclosed at any stage of the research processes. In addition, any data collected, including interview transcripts and observation notes, were stored securely and separated from personally identifiable information. Any identifiable details that could potentially link participants to the data were removed or altered, maintaining strict anonymity throughout each study.

All data collected during the research was handled with the utmost care and respect for privacy. Digital data (e.g., interview recordings, notes) was stored on secure servers, accessible only to authorized researchers. Paper records were stored in locked cabinets. Data was only used for research purposes and was not shared with external parties unless it would have been required by law. In addition to maintaining privacy, this research respected the rights of all participants. Efforts were made to ensure that interviews and observations were conducted in a manner that did not cause discomfort or distress to participants. Additionally, the research was designed to be non-intrusive, ensuring that participants could contribute without feeling coerced or pressured. Throughout the research process, data collection was carried out with attention to accuracy and integrity. The data were analyzed, as far as possible, in a way that was unbiased and without misrepresentation. The findings were reported in a transparent manner, with a focus on representing the experiences and perspectives of participants authentically.

4 Summary of appended papers

4.1 Paper I: When patients get stuck: A systematic literature review on throughput barriers in hospital-wide patient processes

Paper I investigates existing research on the factors impeding efficient hospital-wide patient flows, synthesizing these factors into overarching themes, principal barriers, and underlying root causes. While a substantial body of previous literature addresses barriers to patient flow, few studies adopt a comprehensive, hospital-wide perspective. This paper aims to address this gap by examining process-related barriers to patient flow through a systematic literature review that encompasses entire hospital systems. A total of 92 articles focusing on patient process throughput barriers were systematically screened and selected, aggregating insights into a hospital-wide framework. This review identified 12 primary barriers and 15 corresponding root causes contributing to inefficiencies in patient processes across hospital organizations. Barriers to hospital-wide patient flows can be categorized under five different themes: entry; internal; transfer; management system; and discharge, see Figure 14.

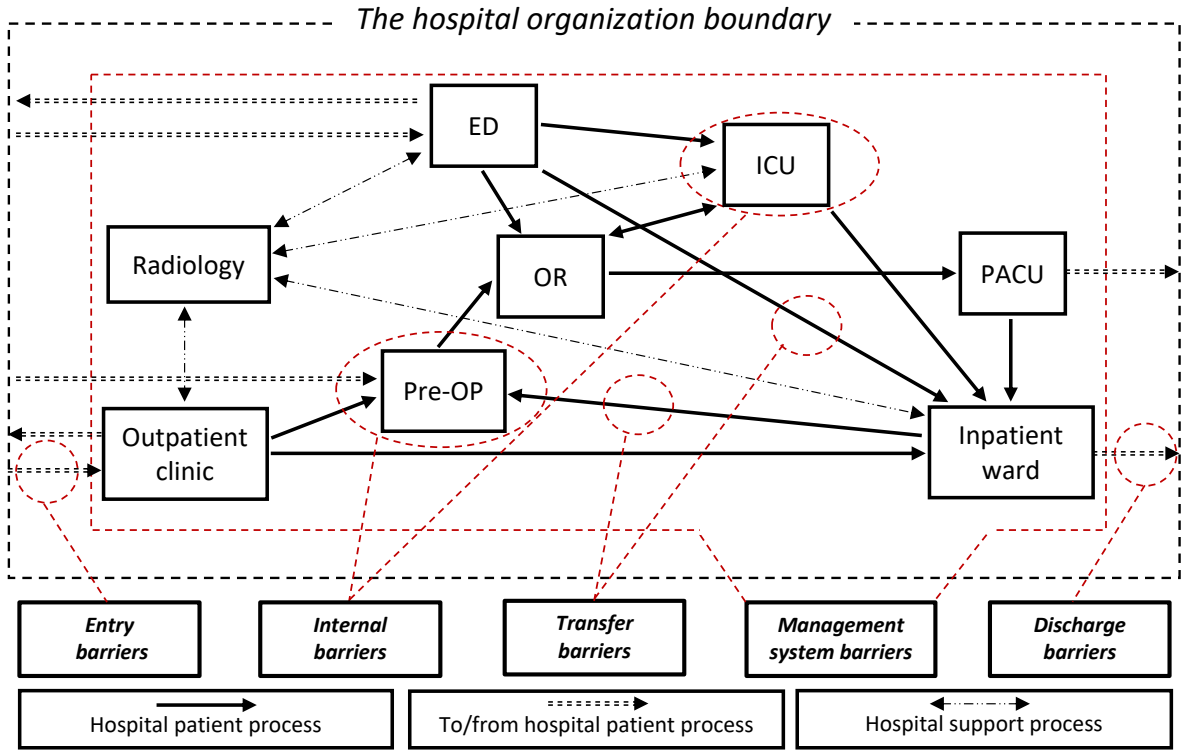

Figure 14: The hospital-wide process model, presented in Paper I

This categorization, with inspiration from the process model presented by Holweg et al (2018), presents that barriers differ, depending on what themes they are associated with. Various barriers to the hospital-wide patient flow appear when patients enter the system or are transferred between internal settings, others appear when patients are internally cared for or when being discharged from the hospital. Last, flow barriers appear when the management system is not capable of managing and balancing the capacity to present demand. The most notable of these barriers are: long lead times; inefficient capacity coordination; and ineffective

patient process transfers. Paper I, however, presents that most barriers can be associated with similar root causes that reappear and create barriers in various instances along the hospital-wide patient flow. The most recurring of those are: inadequate staffing; the absence of standardized procedures and routines; insufficient operational planning; and a lack of functional IT systems.

This study contributes a novel framework intended to assist policymakers and healthcare managers in formulating targeted improvement strategies aimed at enhancing patient throughput within hospitals. The framework elucidates connections between the most prevalent barriers and their associated root causes, demonstrating how multiple barriers can stem from similar root causes and how these elements are intricately interconnected, see Figure 15.

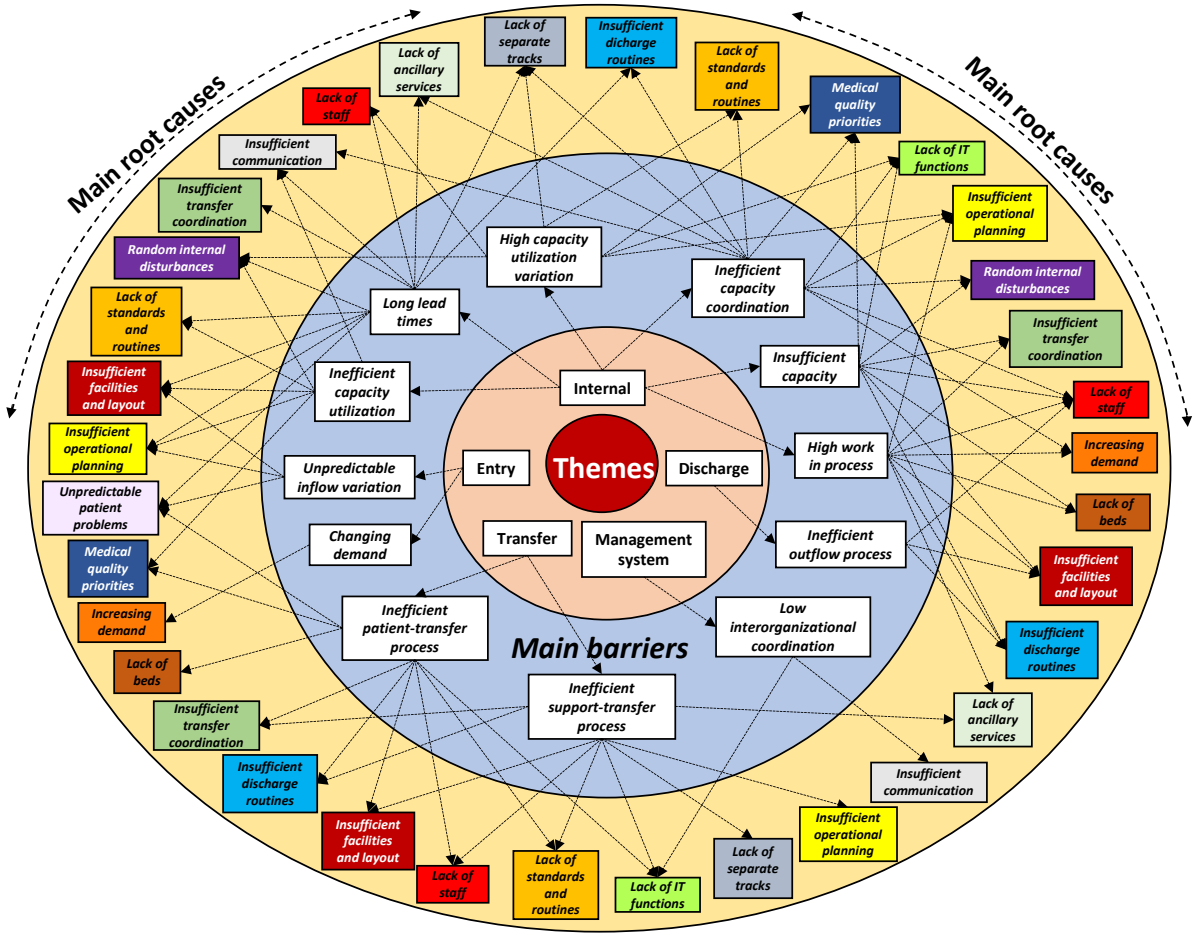

Figure 15: Causality of themes, barriers, and root causes, presented in Paper I

While the findings corroborate barriers previously identified in the literature, this study significantly extends the analysis by organizing them into distinct levels to more effectively capture the complexity underlying inefficient patient processes. Additionally, this paper proposes a process model for hospital-wide patient flow, drawing upon the process categories delineated by Holweg et al. (2018). The adapted model for healthcare settings classifies patient

process barriers into five thematic categories. These categories provide a spatial orientation to each barrier, indicating where along the patient process a particular barrier is likely to occur. Global debates continue regarding optimal healthcare system development to address escalating demand. This paper contributes to these discussions by offering a comprehensive summary of the most critical barriers and associated root causes requiring attention. The findings suggest that inefficient hospital patient throughput arises from both resource-related and work-method-related issues. While resource scarcity is a contributing factor, these results, however, indicate that several other root causes are more readily addressable, potentially yielding capacity improvements without necessitating increased expenditures, a strategy also supported by prior research.

4.2 Paper II: Solutions for improved hospital-wide patient flows – A qualitative interview study of leading healthcare providers

Paper II investigates effective strategies for achieving swift and even patient flow across hospital organizations, proposing a framework to guide improvements in hospital-wide patient flow. This study addresses the research gap concerning comprehensive solutions for optimizing hospital-wide patient flows. Through a comprehensive international semi-structured interview study, senior managers from the world's leading hospitals were interviewed to examine their perceptions of patient flow management and the strategies they employ to enhance patient throughput across their organizations. Participant selection was based on the 2020 international hospital ranking published by *Newsweek magazine*. Following a preliminary pilot study involving three regional hospitals, invitations were extended to senior managers at the top 25 ranked hospitals, of which 18 accepted. A total of 33 interviews were conducted, involving 33 individual hospital managers holding various positions and possessing diverse professional backgrounds.

The findings present a comprehensive list of 50 distinct solutions aimed at improving hospital-wide patient flow. These solutions emphasize the necessity for hospitals to: (1) align their organizational structures; (2) establish robust coordination and transfer mechanisms; (3) ensure adequate physical capacity; (4) develop standardized protocols, checklists, and routines; (5) invest in digital and analytical tools; (6) enhance operational management; (7) optimize capacity utilization and occupancy rates; and (8) pursue external solutions and policy reforms. While these recommendations have been previously discussed in the literature, either as essential developments or as implemented interventions, the novelty of this paper lies in presenting them collectively within a hospital-wide framework, underscoring the importance of addressing all areas concurrently to improve patient flow. This paper builds upon the findings in Study I by expanding the established framework of themes, barriers, and root causes to also include corresponding solutions. It thus provides a more comprehensive framework for hospital managers and improvement agents, detailing not only which barriers warrant attention but also which solutions may effectively address those barriers, see Figure 16.

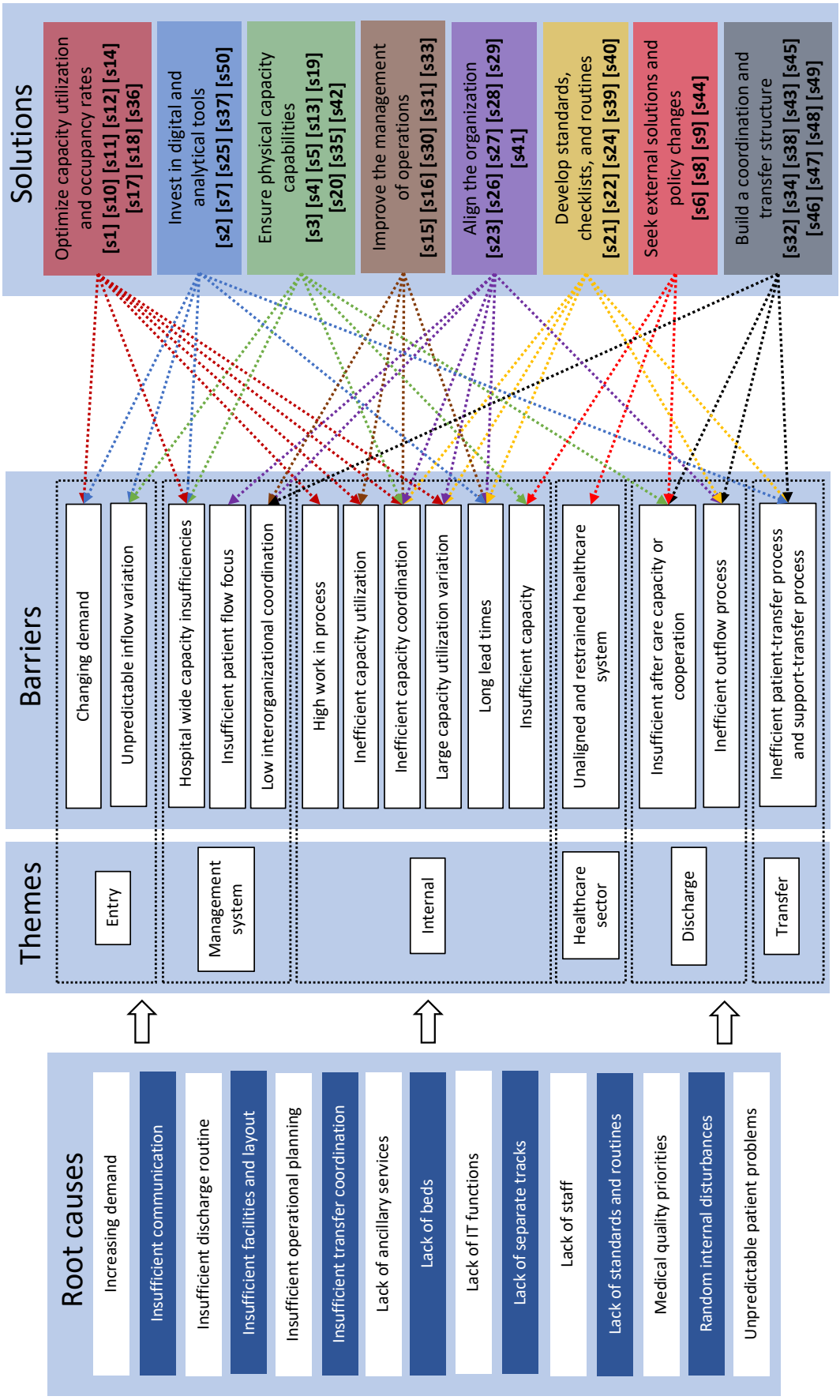

Figure 16: The patient flow improvement framework, presented in Paper II

Interviewees highlighted limited bed capacity and workforce shortages as major constraints. Yet, they also stressed that significant improvements can be made without additional funding by streamlining processes, reallocating resources, and adopting better work methods. A key recommendation is to assign senior leaders with explicit responsibility for flow initiatives, ensuring consistent oversight and organizational commitment. Hospitals must take a strategic view of patient care as a unified process, balancing and coordinating capacity across departments and with external stakeholders.

To achieve sustained improvements, a broad set of professional, organizational, technical, and political dimensions must be considered. Hospitals should pursue both proactive and reactive adjustments to capacity use, aligning flow management with productivity goals and staff well-being. The findings further show that collaboration with actors outside the hospital is vital, as bottlenecks often extend across the healthcare value chain. Nevertheless, many opportunities for progress remain within the hospital itself, particularly through organizational redesign, improved use of existing infrastructure, and technological support. Importantly, although staffing levels are frequently blamed for inefficiencies, the study demonstrates that substantial gains are possible even without increasing expenditures. Finally, the strong convergence in perspectives across European and U.S. hospitals suggests that the identified solutions hold broad relevance across healthcare systems.

4.3 Paper III: Focused operations to improve the patient flow in full-service healthcare organizations

Paper III addresses the critical challenge of enhancing productivity within full-service healthcare organizations to mitigate waiting times and respond to escalating patient demand. This study investigates how operational focus can improve efficiency in full-service hospitals, particularly given the complexity and diversity of patient cases. Specifically, it examines the applicability of the Focused Factory concept within healthcare, assesses the current level of operational focus in traditional full-service providers, and explores potential adaptations of this concept to enhance focus in healthcare delivery. Due to the limited empirical research on operational focus within full-service healthcare settings, an exploratory mixed-method single case study approach was employed. The research was conducted in three distinct phases. First, a systematic literature review was performed to develop a foundational framework aimed at enabling focused healthcare organizations. This framework was subsequently applied in a single case study involving an analysis of patient processes at a full-service medical clinic. Finally, insights from the literature review were integrated with findings from the case study to investigate how established knowledge on achieving operational focus in specialized facilities can inform efforts to enhance operational focus within full-service healthcare providers.

Figure 17: The focused healthcare operations framework, presented in Paper III

The study introduces the Focused Healthcare Operations (FHO) framework, see Figure 17, a tool designed to help healthcare providers assess and improve their operational focus strategies. The framework enables healthcare organizations to assess and enhance their focus strategies, ultimately optimizing operational effectiveness. The framework can help healthcare organizations identify areas that would benefit from being designed as focused processes versus general, adaptable ones, enabling hospitals to enhance efficiency without compromising care quality.

The application of this framework through a single case study of a full-service clinic reveals a fundamental paradox: increasing patient volumes often lead to greater process complexity and variation, contradicting conventional theories that link high volumes to process standardization and efficiency. This insight may help explain the persistent challenges of long waiting times and deteriorating working conditions within healthcare systems. To address this issue, the study introduces a matrix of patient pathways defined along two dimensions: process focus and product (patient) focus, each ranging from low to high, see Figure 18. Pathways are categorized as Exclusive, Focused, General, or Untenable, based on their levels of product and process focus.

To enable full-service providers to increase their patient volumes without increasing patient complexity, the study proposes a dual-focus model. In this model, healthcare services are strategically divided into two categories: Focused Care, specialized services with low process variation, and General Care, broad services characterized by high process variation. Exclusive care should be limited to only strategically important patient groups, while Untenable care should be minimized as much as possible to improve working conditions for healthcare professionals. The approach suggested in this study aims to optimize patient flow and resource allocation without compromising care quality. The implications of these findings extend beyond healthcare, providing valuable insights for other service organizations that struggle with balancing process standardization and complexity. The inability to effectively manage variation may reduce productivity and strain operational capacity, underscoring the broader applicability of the proposed framework.

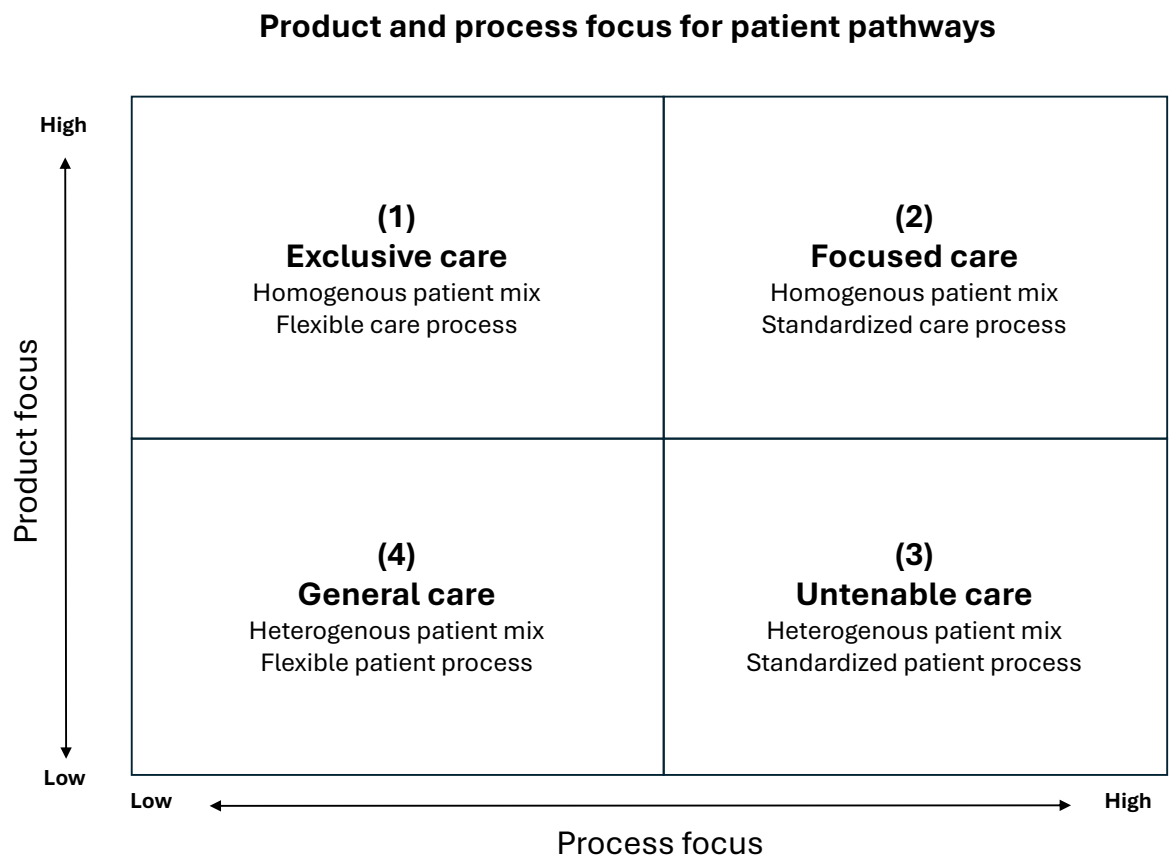

Figure 18: Product and process focus for patient pathways, presented in Paper III

4.4 Paper IV: Operationalizing hospital-wide patient flows: A multiple-case study of leading academic hospitals

Paper IV addresses the growing necessity for research aimed at improving hospital-wide patient throughput to effectively respond to escalating healthcare demand. Despite previous studies identifying numerous challenges associated with optimizing hospital-wide patient flow and proposing various solutions, evidence suggests that hospitals continue to face persistent difficulties in operational capacity planning and coordination within an increasingly dynamic healthcare environment. These challenges constitute significant barriers to achieving efficient, hospital-wide patient flow. This paper investigates how leading healthcare institutions operationalize hospital-wide patient flow through an international multiple-case study. Specifically, it investigates what decisions are made, where they are made, and by whom, across the day and week, to facilitate an efficient hospital-wide throughput of patients. Case selection was based on the 2020 international hospital rankings published by *Newsweek*, a prominent American magazine. Of the top 15 ranked hospitals, five agreed to participate in the study. The research methodology comprised a two-stage process. First, a pre-study involving six interviews was conducted with key stakeholders responsible for managing and developing patient flow within the participating hospitals. Subsequently, week-long on-site visits were

conducted at each hospital, during which between 20 and 29 individuals from various organizational levels were interviewed. These interviews were complemented by comprehensive observations and the collection of archival documents across all units and services critical to the operationalization of hospital-wide patient flow.

This paper demonstrates that hospital-wide patient flow management in large academic hospitals reflects an evolving balance between local autonomy and central coordination. Operational decision-making remains highly decentralized overall, especially in processes that require clinical specificity, admissions, transfers, treatment progression, and discharges. These are predominantly managed at the local, patient-by-patient level by frontline professionals to ensure responsiveness and quality of care. However, local autonomy alone has proven insufficient for handling system-wide pressures, particularly during demand surges. As a result, all hospitals have introduced some form of central oversight to monitor capacity, coordinate across units, and manage bottlenecks. The extent of centralization differs: some hospitals have invested in physical command centers that integrate multiple roles, enable real-time oversight, and facilitate rapid escalation, while others use smaller centralized coordination groups or a more decentralized structure with rotating coordinators. The analysis of different patient flow aspects highlights a layered governance pattern. Entry processes show the strongest central influence, with hospitals using aggregated capacity-control measures such as ambulance diversion, intra-hospital patient transfer reduction, or elective surgery postponement during peak times. Internal patient transfers, while executed locally, depend heavily on central placement decisions to balance demand across units. Internal flow and patient discharges remain mainly local but benefit from central oversight tools that track progression and flag delays. Hospitals with advanced digital systems and dedicated flow roles demonstrate more effective integration of local and central decision-making, while those relying on manual, reactive coordination face greater inefficiencies. Within the broader operations management literature, this paper underscores that hospitals differ fundamentally from traditional industries. Rather than a linear hierarchy of central planning and local execution, hospitals operate in an environment of constant uncertainty, requiring a mix of local and aggregated decisions as well as central and detailed decisions. The various decision types and the rationale behind them are presented in the framework for operational decision-making, see Figure 19. The framework highlights a merging hybrid governance model where traditional planning (central-aggregated decisions) and control (local-detailed decisions) are complemented by decisions concerning the rebalancing (local-aggregated decisions) and reprioritization (central-detailed decisions) of resources as patient needs and system conditions evolve throughout the day.

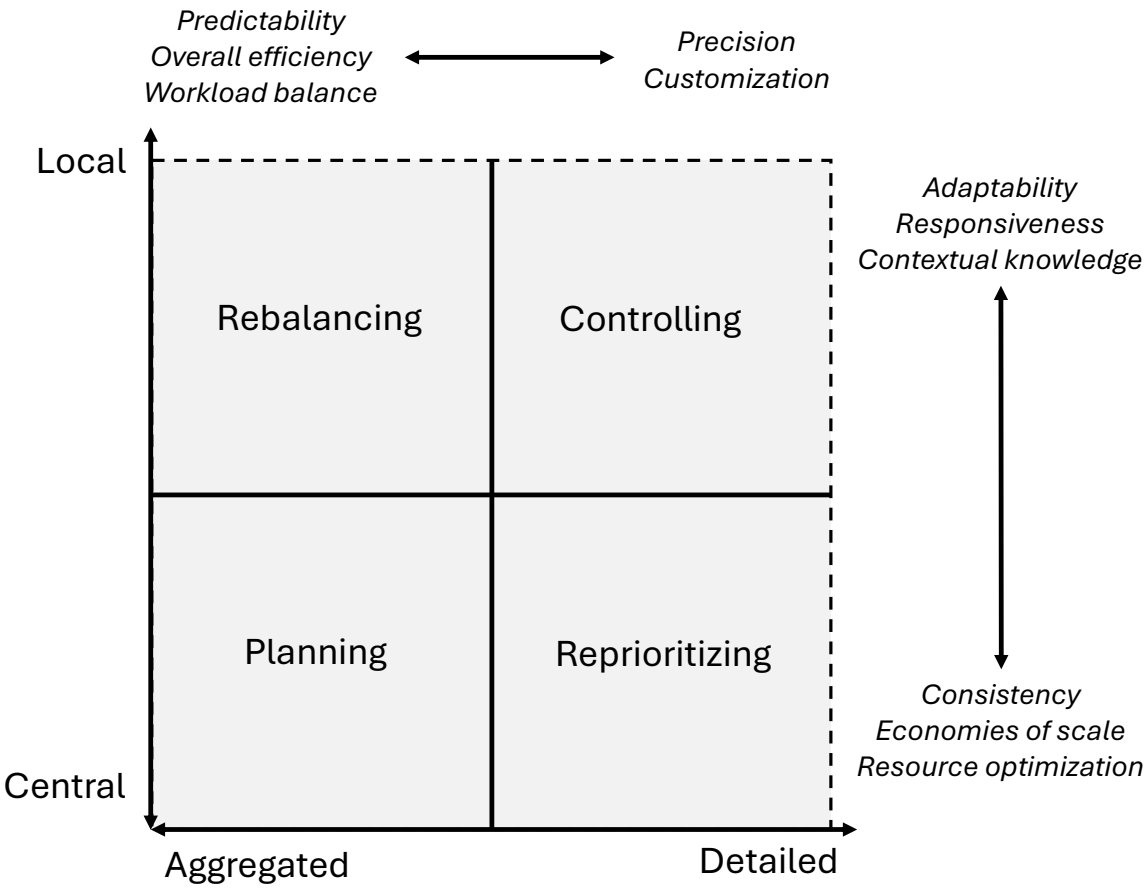

Figure 19: Framework for operational decision-making, presented in Paper IV

The shift toward centralized coordination is not about hierarchical control but about enabling system-wide visibility and facilitating collaboration across autonomous units. Effective centralization in hospitals relies on trust, professional credibility, and data-driven guidance rather than top-down enforcement. Overall, the study contributes to understanding how hospitals can achieve more effective patient flow management. It shows that maintaining strong frontline autonomy is essential for clinical responsiveness, but must be complemented by selective, facilitative central oversight to address interdependencies and manage capacity constraints. For managers, this implies investing in coordination structures, predictive analytics, and relational governance approaches that respect professional autonomy while ensuring system-wide efficiency and patient progression.

4.5 Paper V: Bottom-up perspectives on hospital-wide patient flow – A multi-site qualitative study of solutions to organizational paradoxes

Paper V responds to the growing interest in enhancing healthcare productivity by improving patient flow, a topic that prior research has emphasized must be addressed from a hospital-wide perspective. However, existing literature has largely overlooked the experiences and

insights of frontline healthcare professionals, those directly involved in patient care, while focusing predominantly on the views of healthcare managers. This paper addresses this gap by exploring how doctors and nurses, explicitly excluding those with managerial responsibilities, perceive challenges and potential solutions related to enabling an improved hospital-wide patient flow. The study is based on qualitative interviews with 30 healthcare professionals, equally divided between nurses and doctors, across six hospitals in Sweden, two academic tertiary care hospitals, and four secondary care hospitals. It aims to deepen the understanding of hospital-wide patient flow from a bottom-up perspective and to identify obstacles and enablers for more efficient and balanced patient progression. To analyze the findings, the study applies Paradox Theory (2011), which posits that paradoxes, persistent and interdependent contradictions, often remain latent in organizations but can become salient under conditions such as resource scarcity, institutional change, or decision-making complexity. Seven key paradoxes were identified in relation to efforts to achieve swift and even patient flow:

1. Compliance is expected, but autonomy often overrides routines.
2. Specialized care discourages rigidity, but flow needs structure.
3. Doctors hold authority, but nurses grasp patient flow.
4. Staff aim for workflow control but face constant disruptions.
5. Unit-level loyalties conflict with system-level flow coordination.
6. Flow planning requires foresight, but care remains reactive.
7. Statistical feedback abounds, yet neglects patient flow.

These paradoxes become particularly pronounced under conditions of overcrowding or operational stress, when hospitals tend to revert to narrow medical prioritization rather than broader system-level coordination. The study also presents bottom-up solutions to each of these paradoxes, derived from the professionals' own suggestions. These include stronger adherence to shared routines, more transparent planning, expanded competencies across staff roles, better IT systems for real-time flow management, proactive planning tools, and more engaged and visible leadership. Crucially, participants advocate for a hospital-wide coordination function, supported by shared metrics and regular interdisciplinary communication, to foster a collective understanding of patient flow. Importantly, these proposed resolutions were mapped against the previously developed hospital-wide patient flow framework in Paper II, which is based on managerial perspectives, see Figure 20.

Figure 20: Comparison of bottom-up and top-down solutions, presented in paper V

This comparison reveals substantial alignment between top-down and bottom-up viewpoints. Frontline professionals, like senior leaders, support initiatives such as developing routines and checklists, enhancing coordination structures, improving operations management, and leveraging IT tools. However, their support for standardization is often conditional, based on whether it enables rather than constrains high-quality care. They also emphasize the need to reconfigure roles and responsibilities, particularly by empowering nurses with greater decision-making authority related to patient flow or fostering closer nurse-physician collaboration. Three top-down solution categories, optimizing capacity utilization, ensuring physical capacity, and seeking external or policy-level interventions, were not directly addressed in the bottom-up data. These were interpreted as contextual conditions that render paradoxes more salient (e.g., through resource scarcity), rather than generating paradoxes in themselves.

This paper contributes to the hospital-wide patient flow framework by enriching it with bottom-up insights and demonstrating how paradoxical tensions shape the daily realities of healthcare professionals. It highlights how professionals navigate contradictions between ideals and practice and how targeted resolutions can mitigate these tensions. Ultimately, the study underscores the importance of adaptive, system-wide strategies that are sensitive to the decentralized and dynamic nature of hospital work. A novel contribution of this paper lies in its focus on how reconfiguring roles and redistributing responsibilities among clinical staff may unlock new capacities for improving patient flow, from the ground up.

5 Discussion

Healthcare systems are facing increasing pressures as populations age, the burden of chronic disease rises, waiting times lengthen, and both input and output capacities decrease, all while healthcare expenditures continuously consume a larger share of national GDP (Lorenzoni et al., 2019, OECD, 2023a, WHO, 2024). In response to these challenges, researchers and healthcare practitioners have increasingly turned their attention to patient flow as a potential lever for improving the performance of healthcare systems (Gualandi et al., 2019, Johnson et al., 2020, Litvak and Bisognano, 2011, Vissers et al., 2023). However, both research and practice have predominantly adopted local perspectives on patient flow, focusing narrowly on specific departments or units. This has resulted in a limited understanding of patients' organization-wide care trajectories and the inter-organizational interdependencies that shape the overall patient journey (Kreindler, 2017, Gualandi et al., 2019, Vos et al., 2011). The purpose of this thesis is, therefore, to understand what hinders swift and even hospital-wide patient flows, and to contribute new knowledge on how the hospital-wide flow of patients can be improved. It seeks to generate new theoretical and practical insights into how a hospital-wide approach to patient flow can be developed and implemented. The following chapters present the findings in response to the research questions and discuss the contributions of this work to both academic knowledge and healthcare practice.

5.1 Barriers and underlying root causes that impede the achievement of swift and even hospital-wide patient flows

5.1.1 Barriers, root causes, and interconnectedness

Patient flow, in the context of hospitals, refers to the movement of patients through various stages of care, from admission to discharge. Achieving swift and even patient flows is critical for ensuring timely and equitable care delivery, optimizing resource use, and improving patient outcomes (Devaraj et al., 2013, Johnson et al., 2020). According to the theory of swift and even flows, an ideal flow should be both efficient (swift) and with little variation (even), meaning that delays and bottlenecks should be minimized (Schmenner and Swink, 1998). They are seen as obstacles that prevent the system from achieving optimal performance and desired outcomes, such as for patient flow management within healthcare settings (Hall et al., 2013, Litvak and Bisognano, 2011, Vissers et al., 2023, Villa et al., 2014). Numerous factors are hindering the swift and even flow of patients across hospitals. Facilitating the movement of patients through various activities and treatments along their care trajectories has been a fundamental aspect of every healthcare system since the inception of modern healthcare (Hall et al., 2013). However, the understanding of patient flow dynamics has deepened as healthcare organizations have expanded in both scope and scale, alongside the increasing size and aging of the populations they serve (Kirby and Kjesbo, 2003, Glouberman and Mintzberg, 2001, Thirumalai and Devaraj, 2024). Examining the causes of slow or inefficient patient flows, as well as the factors contributing to prolonged waiting times for care, has been the focus of previous research (D'Andreamatteo et al., 2015, Devaraj et al., 2013, Gualandi et al., 2019, van Lent et al., 2012,

Villa et al., 2014). The purpose of this thesis is, however, to expand that scope to investigate patient flow from a hospital-wide perspective, adopting a comprehensive systems approach to the movement of patients across hospitals.

Barriers to patient flow vary along the hospital-wide process of transforming a patient presenting a request for healthcare until given a diagnosis, referred to another service, or cured (Paper I), see Figure 14. This means that healthcare managers and professionals must adapt their patient flow improvement assessments to what kind of barriers they are planning to overcome, and where they appear along the process. The main barriers to swift and even patient flows are, to a large extent, created by the same root causes, giving the possibility to address all, or multiple, barriers by focusing on these common root causes. Previous research has highlighted multiple barriers to patient flow (Cima et al., 2011, De la Lama et al., 2013, Zhao et al., 2018) appearing in various parts of the patient processes across hospitals. However, this thesis presents a systemic perspective on how these root causes reappear along hospital-wide patient processes and, more specifically, what kind of problems (patient flow barriers) they give rise to. Root causes can be divided into multiple areas, however, a clear separation can be made between those pointing to the need to inject more resources or input capacity and those pointing to the need for change or improvement concerning present work methods. There is plenty of research pointing to a lack of available resources to meet the continuously increasing healthcare demand, (Scheffler and Arnold, 2019, Sen-Crowe et al., 2021, Tamata and Mohammadnezhad, 2023) while others point to how healthcare operations are organized as the main reason behind unmet performance targets (D'Andreamatteo et al., 2015, De Regge et al., 2019, Toussaint and Berry, 2013). This thesis points out that many barriers evolve from a lack of staff or beds, simultaneously as many other barriers are the cause of inefficient and ineffective work routines (Paper I, Paper II, Paper V). Moreover, it points out that barriers and their associated root causes are intertwined and may reinforce each other (Paper I). However, in times of austerity, this thesis indicates that several work-organizational barriers and root causes may be addressed to improve the throughput of patients and the output capacity without increasing expenditures.

5.1.2 (Healthcare) system-wide barriers

The limited hospital-wide perspective in previous research has restricted the exploration of patient flow-related challenges associated with hospital management. Ineffective management systems often struggle to coordinate patient flow across various hospital units, hindered by a lack of real-time analytics (Destino et al., 2019, Johnson et al., 2020, Tortorella et al., 2013) and inadequate tools for centrally monitoring patient flow dynamics (Khalifa, 2017, Kriegel et al., 2016, Verbano and Crema, 2019, Grosman-Rimon et al., 2023). Insufficient focus on hospital-wide patient flow and inadequate capacity assets further impede the ability to respond swiftly to dynamic changes (Paper II). Moreover, the absence of a well-defined flow strategy understood at the unit level limits frontline professionals' ability to act effectively (Paper V).

Operational decisions are often made locally, driven by medical and patient-centered priorities, even though a gradual shift toward central control is emerging (Paper IV).

Regardless of how efficiently hospitals manage internal coordination, improvements are heavily dependent on the broader healthcare system. The fragmented and unaligned system complicates patient flow management, with various actors pursuing their own objectives, making coordination challenging (Paper II). Hospitals are increasingly strained by patients using Emergency Departments as primary care providers, while discharging patients becomes difficult when external actors cannot or will not accept transfers (Paper IV). This imbalance between inflow and outflow leads to congestion throughout the hospital (Paper I). Despite the expectation that overcrowding would prompt patient flow improvement efforts, many initiatives remain short-sighted, focusing on medical priorities rather than addressing patient flow holistically (Paper V). While central-level initiatives are being introduced to facilitate patient flow (Paper IV), a more comprehensive approach is needed to address these persistent challenges.

5.1.3 Low operational patient flow focus

Large general hospitals, which form the backbone of healthcare systems, face the challenge of providing cost-efficient care to vast numbers of homogeneous patient groups while also attending to the most critically ill and complex patients (Persis et al., 2020, Thirumalai and Devaraj, 2024, Christensen et al., 2009, Kuntz et al., 2019). This dual mission is complicated by the fact that hospitals often do not differentiate their patient processes between straightforward, repetitive care for large, homogeneous groups and specialized, complex care for smaller, heterogeneous groups (Paper III). Instead, most processes involve a blend of these patient groups. As patient volume increases, both patient variety and complexity tend to grow, a pattern opposite to what is typically observed in the manufacturing industry. The absence of a clear separation between simple and complex cases likely undermines the ability to balance decisions between what is optimal for individual patients and what best serves the broader population or overall patient flow (Paper IV and Paper V). When patient congestion rises without clear differentiation between high-complexity and low-complexity cases, medical prioritization becomes the sole guiding principle. This approach further reduces throughput and intensifies patient congestion, perpetuating inefficiencies and straining healthcare resources.

5.2 Solutions and improvement strategies that effectively address existing barriers to achieve swift and even hospital-wide patient flows

5.2.1 Improving the management system of hospitals

There are various solutions and improvement strategies aimed at enhancing hospital-wide patient flow. This thesis supports previous research indicating that the significant variation in healthcare processes is problematic and must be minimized to increase patient throughput (Cima et al., 2011, Sunder, 2013, Villa, 2022, Vissers et al., 2023). While varying demand is a challenge, inconsistencies in how internal capacity is utilized are equally problematic (Paper I and Paper II). Greater structure, standardization, routines, and effective leadership are essential (Paper II) and actively sought after (Paper V) to reduce unpredictability and improve efficiency in healthcare delivery. A key contribution of this thesis is highlighting the need to strengthen the management system's role in facilitating the efficient transfer of patients throughout the hospital (Paper II). It is the management system, along with the centralization of decision-making power, that addresses the needs of the broader patient population and manages the hospital's overall capacity (Paper IV). Without improvements to the management system, decision-making remains local, prioritizing individual patients at the expense of hospital-wide efficiency (Paper IV). This local approach often leads to conflicts between hospital departments and professional groups during periods of scarcity and change (Paper V). For a more effective management system, hospitals must enhance inter-organizational coordination and ensure consistent, hospital-wide capacity to address imbalances between demand and capacity throughout the day and week. Achieving this requires fostering a heightened focus on patient flow, understanding its demands, ensuring collective commitment, and emphasizing how everyone benefits from streamlined processes (Paper II, Paper IV, Paper V).

5.2.2 Strategic, tactical, and operational solutions

Achieving a swift and even hospital-wide patient flow is a complex challenge that likely requires multiple parallel improvement initiatives aimed at reorganizing the hospital in various ways. Ultimately, the effectiveness of these initiatives and improvement projects is determined at the operational level. Prioritizing patient flow involves implementing organizational and technological improvements, as well as developing new physical spaces to support this goal (Paper II). However, the true determinant of success lies in where mandate and decision-making power are placed (Paper IV). It is essential that those with authority fully understand patient flow and recognize the consequences of an (un)even and (un)swift flow on the hospital's overall performance (Paper IV and Paper V). What can be achieved at the operational level is enabled by decisions made at the tactical level, which in turn are influenced by strategic-level planning. Effective feedback loops between these levels are crucial for continuous operational

improvement (Paper II and Paper V), something also previously acknowledged (Vissers et al., 2023).

Healthcare managers (Paper II) and healthcare professionals (Paper V) hold high expectations for new technologies to enhance patient flow, and numerous innovative solutions are being tested and implemented (Paper II and Paper IV). However, genuine progress in patient flow management requires more than technological advancements, it demands a profound cultural shift (Paper I, Paper II, Paper IV, and Paper V). This shift involves balancing the needs of the broader system with the needs of individual patients (Paper IV and Paper V). Although new technologies can be rapidly implemented at an operational level, they can be discarded just as quickly if they do not align with a sustainable, strategic vision. Achieving swift and even hospital-wide patient flows requires long-term strategic commitment, placing patient flow at the forefront of the agenda (Paper I and Paper II) and fostering stronger connections between managers and professionals throughout the hospital (Paper II and Paper V). To effectively measure and respond to patient flow, strategic objectives must be translated into clear, actionable steps at the operational and local levels (Paper IV). Both local and central professionals must be actively engaged in promoting and embedding a hospital-wide patient flow mindset (Paper IV and Paper V). Ultimately, enthusiasm for improving patient flow will only succeed if professionals can clearly see how these improvements benefit themselves, their patients, and their colleagues throughout the hospital (Paper V).

5.2.3 Swift and even alongside unswift and uneven patient flows

The complexity facing large general hospitals is great when care processes are not separated between complex and simple (Persis et al., 2020, Thirumalai and Devaraj, 2024, Christensen et al., 2009, Kuntz et al., 2019). The focused factory concept claims that no process can become competitive if performing too many varying products or services (Skinner, 1974), which is the case for most general hospitals and other full-service care providers. Hospitals need to separate complex from simple, either as a whole organization or as various parts of the organization (Paper III). Enabling a swift and even hospital-wide patient flow requires a reduction in variation to make processes more plannable and workdays more foreseeable for healthcare professionals (Paper V). Full-service healthcare providers cannot and should not avoid performing care to small complex patient groups arriving in a large variety. However, to stay competitive and provide cost-efficient care, large homogenous patient groups need to be cared for in processes separate from the smaller complex high-variety patient groups (Paper III). There is also a great need to identify, redesign, and/or remove patient groups of high variety in processes given little flexibility and limited resources to avoid untenable patient processes and unsustainable work environments (Paper III).

5.3 Centralization versus local autonomy

5.3.1 Previous insights

Achieving swift and even hospital-wide patient flow requires balancing centralization and local autonomy. Centralization enables coordination, standardization, and efficient resource use, while local autonomy supports contextual responsiveness, professional ownership, and innovation (Braithwaite et al., 2023). Functions that depend on visibility and resource optimization, such as capacity management and bed allocation, are typically centralized. Central bed management improves throughput, reduces emergency department (ED) overcrowding, and minimizes ambulance diversions (Villa et al., 2014, Lovett et al., 2016b). These systems use dashboards and predictive analytics to coordinate admissions, transfers, and discharges across departments (IHI, 2020, Grosman-Rimon et al., 2023). Similarly, centralized staffing pools and policy frameworks ensure fair personnel distribution, reduce administrative burden, and standardize safety and infection control procedures (Blevins et al., 2023, Kane et al., 2019, Piper, 2023).

By contrast, daily clinical decision-making and ward-level operations are best handled locally. Teams on the ground are most attuned to patient acuity, staff skills, and contextual demands. Excessive centralization risks rigidity and frontline demotivation (Johannessen et al., 2020, Lalani et al., 2023, Mebrahtu et al., 2023). Local scheduling and admissions management allow wards to respond flexibly to their unique demand patterns, while decentralized quality improvement (QI) initiatives tend to generate stronger engagement and contextually grounded change (Shooshtari et al., 2017). Some responsibilities require shared governance. For instance, central protocols for patient transfers or standardized care pathways must be adapted locally to fit workflows and patient demographics (Lund Hansen et al., 2024, Kaur et al., 2024). Similarly, surge planning benefits from central thresholds and escalation policies but requires local discretion in execution (IHI, 2020). Overall, the literature supports hybrid governance: centralization for cross-departmental coordination and resource optimization, local autonomy for clinical responsiveness, and shared structures, such as flow steering committees, for bridging the two (IHI, 2020, Kaur et al., 2024).

5.3.2 Insights from this thesis

This thesis extends the debate in several ways. First, it emphasizes that hospitals must broaden their definition of performance. Flow-related metrics, often overshadowed by clinical and financial indicators, should be recognized as equally critical. Studies II and V demonstrate that aligning local KPIs with centrally defined flow targets strengthens legitimacy and visibility of flow across the organization, complementing earlier findings (IHI, 2020, Lovett et al., 2016b). Second, the research highlights that many flow bottlenecks, such as scheduling misalignments or interdepartmental frictions, are systemic and cannot be resolved locally. Study II shows that these require central orchestration, while Study IV demonstrates how predictive models can

anticipate demand and guide surgical scheduling. Here, centralization enables not just coordination but proactive, strategic anticipation. Importantly, Study IV also shows that modern command centers increasingly operate as advisors rather than enforcers, relying on trust and relational credibility rather than strict authority.

Third, the thesis identifies the risks of unchecked decentralization. Studies III and V reveal that excessive local autonomy drives subspecialization, fragmentation, and rising process variation. Instead of flexible pathways for heterogeneous patients and standardized tracks for high-volume groups, many units accumulate narrow categories, creating inefficiency and confusion. In such contexts, staff and patients struggle to navigate the system, reinforcing the need for stronger central leadership. Contrary to assumptions of clinician resistance, Study V shows many professionals welcome centralization when it reduces friction and increases predictability.

Finally, the findings point to a dynamic evolution of governance. While patient-level decisions largely remain local, Study IV documents a trend toward centralizing decisions that span departments, such as transfers and scheduling. Governance is thus best seen as an adjustable lever, continually recalibrated as complexity and predictive capabilities evolve. Together, these insights reframe centralization as a relational and temporal process rather than a static structural choice.

5.3.3 Finding the right balance

The field of OM traditionally emphasizes clearly defined, repeatable processes for efficiency (Schmenner and Swink, 1998, Slack and Brandon-Jones, 2019, Holweg et al., 2018). Yet, healthcare processes are semi-structured, with significant case-to-case variation. This research shows that central oversight is vital for managing interdependencies and preventing fragmentation caused by growing specialization (Studies III and V). Centralization thus functions as a process enabler, integrating pathways across specialties while preserving space for local customization.

The theory of swift and even flows (TSEF) posits that faster, more predictable flows improve performance (Schmenner and Swink, 1998). Applied to healthcare, this means reducing delays, waste, and patient waiting (Devaraj et al., 2013, Johnson et al., 2020). This dissertation supports that view, showing how centralization reduces inefficiencies, mitigates system-level variation, and facilitates anticipatory scheduling (Studies II and IV). However, the findings also highlight TSEF's limits: variation in healthcare is not merely technical but organizational, driven by divergent goals and siloed decision-making. Centralization works only when underpinned by trust, shared metrics, and alignment.

The Focused Factory concept (Skinner, 1974), adapted to healthcare, promotes specialized units or pathways for efficiency (Bredenhoff et al., 2010, Hyer et al., 2009). Studies III and V caution against its uncritical application. While focused pathways improve efficiency for

homogeneous groups, excessive subspecialization fragments patient journeys and reduces agility. A dual-pathway model, where general and focused flows coexist under central oversight, offers a more sustainable solution. Centralization here acts as a counterbalance, aligning specialization with hospital-wide flow.

Hospitals must deliver both standardized high-volume services and flexible patient-centered care, reflecting their nature as "professional bureaucracies" (Klassen and Rohleder, 2004, Thirumalai and Devaraj, 2024, Glouberman and Mintzberg, 2001), This research shows how hybrid governance can evolve over time: hospitals may begin with local autonomy but increasingly centralize as complexity rises (Study IV). Professionals themselves recognize these limits, supporting stronger alignment (Studies II and V).

In sum, this dissertation challenges binary notions of centralization versus decentralization. Governance structures shape not only coordination but also professional behavior and system performance. Effective patient flow requires viewing centralization and autonomy as dynamic, interdependent levers, continuously adjusted to match organizational strategy, structure, and capacity.

5.4 Practical contributions

Healthcare managers and professionals operate within an environment characterized by high dynamism, overwhelming complexity, and often unattainable performance standards. The stakes are exceptionally high, with people's lives on the line, which presents fundamentally different conditions for designing and implementing swift and even organizational flow compared to manufacturing industries. The ongoing healthcare crisis is acutely felt in most hospitals, where stress and burnout are prevalent, further aggravating staffing shortages. However, many challenges appear to stem from a lack of understanding regarding what improvements could facilitate a more swift and even flow of patients through hospitals.

Hospitals could significantly benefit from a more centralized approach to managing patient flow. Centralization would enable continuous observation of evolving dynamics throughout the day and week, allowing for coordinated responses that effectively allocate capacity where it is most needed. Such coordination also involves bridging gaps between various hospital departments and fostering collaboration among healthcare professionals. Many issues arise from the tendency of hospital departments to prioritize their own resources and optimize capacity within their immediate areas, often to the detriment of the broader system. This shortsightedness frequently results in greater congestion and heightened stress across the hospital.

Drawing from the analysis of barriers and solutions, this thesis presents an improvement framework that visualizes the relationships between patient process barriers, their underlying root causes, and potential solutions, see Figure 16. The framework also aligns with the process

model by illustrating how these barriers and solutions are connected to broader process themes. This framework offers hospital managers and decision-makers multiple approaches to enhancing hospital-wide patient flow. One approach is to identify a specific root cause or barrier and then seek appropriate solutions for implementation. Another strategy involves selecting a feasible solution and examining which barriers or root causes it may help address. Alternatively, focusing on a particular aspect of the patient process, as outlined in the process model, can reveal associated problems and relevant solutions. Consequently, this framework can serve as a valuable tool for designing effective improvement strategies.

Designing efficient patient care processes is a complex endeavor, particularly within the intricate environment of the healthcare sector. This challenge is especially pronounced in full-service healthcare institutions, which must simultaneously manage large volumes of relatively homogenous patients alongside small numbers of highly complex cases. The result is a highly demanding managerial landscape, where default strategies often rely on "doing more with less" or simply "running faster," approaches that are typically unsustainable and inefficient. To address this, full-service hospitals must improve their ability to distinguish between complex and simpler patient groups. Such differentiation is essential to increase patient throughput, enhance cost-efficiency, and improve working conditions for healthcare professionals. Paper III contributes to this objective by introducing a practical tool, the Framework for Focused Healthcare Operations (Figure 17), designed to support both the analysis of current strategic and operational focus and the subsequent redesign of patient processes based on those findings. The framework identifies ten key areas that must be evaluated for each existing patient process to assess its current level of operational focus. This evaluation serves as the basis for determining how to redesign or implement new, more focused processes. While Paper III offers an initial proposal for how to assess each area, the thesis emphasizes that the evaluation criteria are likely to yield the best results when tailored to the specific context of each medical specialty.

Healthcare providers frequently encounter difficulties in operationalizing hospital-wide patient flows. One core challenge lies in the persistent tension between local autonomy, emphasizing front-line decision-making, and centralized control aimed at system-wide coordination. Healthcare professionals and front-line managers regard local responsiveness and patient-centered care as essential for ensuring high medical quality and patient safety. In contrast, those operating at a more centralized level, with a hospital-wide perspective, view central decision-making and coordinated patient flow management as critical for the equitable and optimal allocation of resources in response to current and evolving demand. These differing perspectives reflect a broader disconnect: while front-line professionals may perceive their units as relatively independent, central managers recognize the high degree of interdependence across hospital departments and services. This thesis contends that although local autonomy and responsiveness to changes are vital, many of the challenges experienced at the front line can be traced to a lack of clear central mandates, decision-making authority, and coordination. The absence of a cohesive, system-level approach can lead to fragmented and sometimes

contradictory responses to complex operational issues. As such, improving hospital-wide patient flow requires not only the implementation of new organizational structures and roles to support coordination but also the deliberate development of roles and responsibilities among healthcare professionals. These roles must be designed to support swift and even patient flow while safeguarding medical quality and patient safety.

5.5 Theoretical contributions

The research presented in this thesis is grounded in practice, as the research questions were motivated by the real-world challenge of how to achieve swift and hospital-wide patient flows (Schwarz and Stensaker, 2014). Adopting an abductive approach, iteratively moving between empirical data and theoretical frameworks, enabled the development of several novel theoretical perspectives that contribute to established theories and bodies of knowledge. The key contribution of this thesis lies in applying and extending Process Theory, the Theory of Swift and Even Flows (TSEF), and the Focused Factory concept to the domain of Healthcare Operations Management (HOM), thereby enriching and advancing this field of research.

Godfrey-Smith (2003) argues that "scientific theories are not just summaries of data, but tools for understanding, and they allow us to connect disparate observations into a unified picture". He further emphasizes that the purpose of theories is to facilitate the cumulative and structured development of scientific knowledge. In line with this view, the findings presented in Paper I and Paper II, derived from a systematic literature review and an extensive international interview study with healthcare managers, synthesize fragmented insights into a cohesive understanding of the factors that hinder and promote efficient, organization-wide patient flows in hospitals. The hospital-wide patient flow improvement framework, Figure 20, integrates multiple data points drawn from diverse areas of patient flow research. This framework enables other scholars to appreciate the interconnections among barriers, their underlying root causes, and corresponding solutions across hospital systems.

Process Theory, building on TSEF, emphasizes the importance of identifying and eliminating bottlenecks, whether stationary, moving, or one-time, that constrain process performance (Goldratt, 1994, Schmenner and Swink, 1998, Holweg et al., 2018). Paper I explores barriers to achieving swift and even hospital-wide patient flows and identifies their underlying root causes. The findings suggest that bottlenecks can result from limited capacity (barrier) due to inefficient work methods (root cause), just as inefficiently coordinated capacity (barrier) may stem from staff shortages (root cause). Thus, in complex organizational systems such as hospitals, resource-related bottlenecks (typically stationary) and work-method-related bottlenecks (often moving) are closely interrelated and tend to reinforce one another. Addressing such bottlenecks in large, complex systems, characterized by multiple interacting and dynamic elements, requires top-down, system-wide approaches to avoid sub-optimization. Literature on how to break bottlenecks mostly considers this to be an activity happening at the

front-line through continuous improvement projects (Holweg et al., 2018, Schmenner and Swink, 1998). However, in large complex organizations like hospitals, local initiatives must likely be paired with central support to understand what bottlenecks to break and what they seem to depend on.

Process Theory and HOM posit that efficient process throughput relies on a well-integrated management system capable of effectively managing and controlling available capacity to align with current and projected demand (Holweg et al., 2018, Villa, 2022, Vissers et al., 2023, Lee et al., 1997, Schmenner, 2015). In healthcare, this remains an underexplored area, as little prior research has examined barriers to patient flow that originate within the management system itself (Paper I). This thesis argues that one reason for the underdevelopment of hospital management systems is the organizational ambiguity surrounding the distribution of decision-making authority, specifically, balancing local autonomy for responsiveness with centralized coordination to manage interdependencies across clinics and services (Papers IV and V). Developing an integrated and effective management system requires organization-wide understanding and acceptance of its functions and decision mandates (Gualandi et al., 2019, Holweg et al., 2018, Vissers et al., 2023). Unlike manufacturing industries, where centralized, aggregated planning is systematically translated into local, detailed execution, healthcare lacks a comparable level of structured management and control (Franklin et al., 2023, Grosman-Rimon et al., 2023, Hulshof et al., 2017, Vissers et al., 2023). Paper IV highlights the need for patient progression decisions concerning individual cases to be continuously made at the central level, while decisions regarding the rebalancing and reprioritization of multiple patients must occur at the local level. Consequently, healthcare management systems must be designed to accommodate greater deviations from planned operations at the operational level, thereby enabling the resolution of emerging problems and maintaining a hospital-wide perspective on patient flow (Papers II and IV).

In his seminal work The Focused Factory, Wickham Skinner (1974) argued that firms must make strategic trade-offs between competing operational objectives, such as cost, quality, speed, and flexibility, and that failing to do so results in suboptimal performance across all dimensions. This principle has since been repeatedly validated and reinforced in the operations management literature (Holweg et al., 2018, Hyer et al., 2009, Schmenner and Swink, 1998). Healthcare, however, represents an industry in which these trade-offs are frequently ignored, often attempting to achieve all performance objectives simultaneously. This tendency leads to a performance of slow throughput, high costs, and cumbersome working conditions. A key reason for this, and a fundamental pillar for most healthcare systems, public in particular, is that they are structured to provide care to all patients, regardless of cost or complexity. Nevertheless, Paper III demonstrates that the core tenet of focused operations theory still holds: as patient volume increases, for organizations attempting to achieve all performance objectives, so too does the variety and complexity, exacerbating inefficiencies in cost, speed, and professional effort. Despite this, full-service healthcare providers can still enhance performance

by organizing internally to create more focused operational units. Focus can be applied at lower levels of the organizational hierarchy (Hyer et al., 2009), enabling improvements even within broader, unfocused systems. The theoretical contribution of this thesis lies in demonstrating that focused and unfocused operations can coexist within the same organization to support the diverse goals of full-service healthcare. Focus does not necessarily need to be achieved at the highest organizational level; rather, it can, and should, be strategically implemented at levels where it is feasible. The critical requirement is to establish clear distinctions between high-volume, low-variety processes and low-volume, high-variety processes, thereby aligning operational design with process characteristics.

5.6 Limitations

In Paper I, while a rigorous systematic review methodology was applied, no quality assessment of the included articles was conducted. The aim was to capture all relevant research for a comprehensive summative analysis of root causes. Instead of quality assessment, validity was inferred from the large number of studies included. Additionally, restricting the review to English-language studies may have excluded valuable research. Lastly, attempting to understand a complex system by summarizing its parts may overlook certain perspectives. However, until large-scale hospital-wide studies on patient throughput are feasible, synthesizing existing research of parts of the hospital organization remains our best approach.

In Paper II, although a qualitative semi-structured interview method was employed with a substantial pilot study, the interviews were conducted by a single researcher, introducing potential bias in questioning and guiding participants. The online format also limited the ability to capture body language and facial expressions, potentially affecting the completeness of responses. While three researchers independently analyzed the transcriptions, the shared background within the same field may have constrained the range of interpretations. Additionally, the study focused on large academic hospitals, whose perspectives on efficient patient flow may not apply to all hospital types. For a more comprehensive view, research involving secondary care providers and other professional groups, such as physicians and nurses, is needed.

In Paper III, a key limitation is its reliance on a single case study, which limits generalizability. However, the selected medical clinic was designed to resemble a full-service hospital, enhancing the applicability of the findings to similar healthcare organizations. Additionally, while we developed a framework to guide healthcare organizations in defining focus strategies, evaluating operational focus, and implementing improvements, it remains untested, limiting its validity. Although three researchers independently analyzed the data, our shared background in Operations Management may have introduced bias. Finally, the lack of a validated tool for assessing focus in each evaluation area is another limitation. Developing a universally adaptable tool is challenging, and individual organizations may need to establish their own measurement methods.

In Paper IV, all data collection was conducted by a single researcher, potentially introducing bias in questioning and guiding participants. The design of each research visit varied, as it was co-developed with participants during pre-visit interviews, who naturally had different priorities regarding what to observe and who to interview. Additionally, the absence of an on-site pilot study may have affected the quality of data collection. Another limitation is the generalizability of findings, as conclusions are based on only five cases from three countries. The in-depth study of these cases required, however, significant time and effort, making broader inclusion unfeasible.

In Paper V, a single researcher conducted the whole study and collected all the data. The analysis was also carried out by the same individual, potentially introducing bias and limiting the range of interpretations. While a follow-up workshop to discuss findings with participants could have strengthened the interpretations, the effort required to arrange each interview made this impractical. Additionally, including participants from countries beyond Sweden would have improved generalizability, as some findings may be specific to the Swedish context.

6 Conclusions and future research

6.1 Conclusions

This thesis set out to investigate how hospitals can achieve swift and even hospital-wide patient flows, examining both barriers and solutions. First, the research shows that barriers to patient flow are systemic and interconnected. They arise not only from resource shortages such as staff and beds but also from inefficient routines, fragmented coordination, and a lack of hospital-wide management structures. Importantly, these barriers reinforce one another, creating persistent bottlenecks that local initiatives alone cannot solve. Second, a key contribution is the insight that hospital management systems are underdeveloped in relation to patient flow. Without central coordination, predictive tools, and shared flow-related metrics, hospitals remain locked in local, short-term decision-making that favours individual patients but undermines overall system performance. Third, the thesis shows that patient flow governance is not about choosing between centralisation and local autonomy. Instead, hospitals need a hybrid model: centralisation of functions like bed management, predictive planning, and policy standardisation; decentralisation of clinical decisions and local quality improvement. Crucially, this works best when centralisation is advisory and trust-based rather than command-and-control. Fourth, differentiation between patient groups is essential. Large hospitals should not manage simple, high-volume patients in the same flows as complex, heterogeneous ones. Blending them creates inefficiencies and congestion. Separation improves throughput, efficiency, and working conditions for staff. Fifth, while new technologies offer promise, they are not sufficient. Real improvement requires cultural and structural change: cultivating a shared hospital-wide commitment to flow improvement, aligning local units with hospital-wide priorities, and building organizational structures that enable effective management and decision-making to ensure the smooth daily progression of patient flow.

From a theoretical perspective, this thesis contributes to Process Theory and TSEF by demonstrating that solving flow bottlenecks is not only technical but also organizational, rooted in divergent goals and siloed decision-making. It reinterprets the Focused Factory concept by showing that focused and unfocused flows can coexist within the same organization, provided they are strategically governed. It also extends existing theory within Healthcare Operations Management by showing that, unlike manufacturing, where decisions are split between central-aggregated and local-detailed levels, within dynamic contexts like hospitals decisions regarding the reprioritization of individual cases must often be made at a central level, and decisions regarding the rebalancing of multiple cases must often occur at a local level in order to stay responsive to unpredictable demand.

Concerning managerial implications, this thesis offers a set of frameworks and models that can guide hospital managers and policymakers in improving patient flow. The improvement framework links barriers, root causes, and potential solutions, providing a practical tool for diagnosing systemic problems and designing targeted interventions. The Framework for Focused Healthcare Operations supports managers in evaluating and redesigning patient processes according to their degree of complexity and homogeneity. In practice, hospitals would benefit from:

1. strengthening central coordination mechanisms, particularly in capacity allocation and predictive planning,
2. embedding hospital-wide flow-related metrics into performance systems,
3. differentiating between high-volume and complex patient flows, and
4. developing governance structures that balance central guidance with local adaptability.

In conclusion, this thesis argues that achieving swift and even patient flow in hospitals requires more than isolated efficiency projects. It calls for a hospital-wide perspective that integrates structural, cultural, and governance dimensions. Patient flow must be understood as both an operational and strategic concern, central to the hospital's mission of delivering timely, equitable, and high-quality care. By combining systemic analysis with practical tools, this research provides both theoretical contributions and actionable insights to support the ongoing transformation of healthcare operations.

6.2 Future Research

Future research should explore how the proposed solutions and improvement strategies from this thesis can be effectively implemented, transitioning from conceptualization to action. This could involve applying the framework of barriers, root causes, and solutions from Paper II to observe hospital organizations as they implement measures to address patient flow challenges. Hospitals may opt to implement solutions incrementally, which can also be studied using this approach. As suggested in Paper II, successful implementation will likely require improvements in organizational, physical, and technological aspects, along with strong leadership commitment and awareness of the need for change.

Another research avenue involves examining hospital productivity and patient flow performance based on differing coordination models, being more centralized versus more decentralized. A centralized approach aligns more closely with the thesis's proposal of centrally observing, coordinating, and addressing system-wide patient flow issues rather than relying on local efforts. Future studies should also assess how increased centralization or decentralization impacts other performance indicators, including medical quality, patient and staff satisfaction, and overall population health.

Technological advancements are accelerating, from optimization modeling and machine learning to new possibilities offered by AI. While hospitals have long utilized cutting-edge technology for medical examinations and treatments, the use of advanced technology for managing and controlling patient flow remains surprisingly limited. Many healthcare professionals report that their IT systems are outdated, often dating back to the mid-1990s. This technological gap makes patient flow management largely manual, relying on memory and prioritization skills under pressure from medical, nursing, and administrative staff. However, many hospitals and healthcare professionals believe technology can play a greater role in improving patient flow management. Advanced systems could offer predictive views of patient progression, provide probabilistic hospital-wide scenarios for scheduling surgeries and appointments, and support real-time prioritization advice during overcrowding. Hence, further research is needed to examine which technologies are being implemented to enhance patient flow and to evaluate their actual impact on performance

The growing challenge for large general hospitals amid the rise of specialized healthcare providers is worth further investigation. This dilemma resembles the classic "make or buy" question. The current situation is unsustainable, as general hospitals are expected to provide cost-efficient care for the sickest patients while also delivering high-volume, routine care as the backbone of the healthcare system (Christensen et al., 2009, Kuntz et al., 2019). Problems arise when specialized hospitals selectively treat profitable patient groups, leaving general hospitals with a more complex, sicker population that is harder and costlier to treat (Strumann et al., 2022, Kumar, 2010, De Regge et al., 2017, Dexter et al., 2019). Consequently, many healthcare professionals leave for smaller specialized hospitals that offer higher pay and less stressful environments. Furthermore, large general hospitals carry extensive teaching responsibilities, a burden not shared by smaller specialized facilities (Dabhilkar and Svarts, 2019, Strumann et al., 2022). More research is needed to determine when general hospitals should outsource (buy) care for certain patient groups from specialized hospitals and when to retain it in-house. Do hospitals make strategic decisions on what care to outsource (buy) and what consequences that will have, or are the general hospitals given no choice but to outsource care "picked" by specialized hospitals, no matter the consequences?

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Paper I

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When patients get stuck: A systematic literature review on throughput barriers in hospital-wide patient processes

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ABSTRACT

Hospital productivity is of great importance to policymakers, and previous research demonstrates that improved hospital productivity can be achieved by directing more focus towards patient throughput at healthcare organizations. There is also a growing body of literature on patient throughput barriers hampering the flow of patients. These projects rarely, however, encompass complete hospitals. Therefore, this paper provides a systematic literature review on hospital-wide patient process throughput barriers by consolidating the substantial body of studies from single settings into a hospital-wide perspective. Our review yielded a total of 2207 articles, of which 92 were finally selected for analysis. The results reveal long lead times, inefficient capacity coordination and inefficient patient process transfer as the main barriers at hospitals. These are caused by inadequate staffing, lack of standards and routines, insufficient operational planning and a lack in IT functions. As such, this review provides new perspectives on whether the root causes of inefficient hospital patient throughput are related to resource insufficiency or inefficient work methods. Finally, this study develops a new hospital-wide framework to be used by policymakers and healthcare managers when deciding what improvement strategies to follow to increase patient throughput at hospitals.

1. Introduction

Demand for health care is rising as a consequence of changing demographics and increasing multi-morbidity [1,2]. Hospitals, meanwhile, are struggling with capacity constraints, insufficient productivity and increasing financial deficits [3–7]. The necessity to improve the health care system is great and further intensified as previously increasing annual rates for healthcare budgets are starting to stagnate or even decrease [8,9]. Consequently, policymakers are searching for options for how to improve the situation, leading them to policies of both cost containment and production improvement [6,10,11]. Cost-containment strategies such as austerity measures may, however, result in short-term cost-savings but are likely to lead to significant costs for society in the long run [9]. The imperative for production improvement projects as a means of lifting the results of the healthcare sector is, therefore, growing [8,12,13].

Accounting for the productivity of hospitals when assessing the performance of a healthcare system has been emphasized by the World Health Organization (WHO) [14], the Organization of Economic Cooperation and Development (OECD) [15,16] and the Institute of Medicine (IOM) [17]. Through their health-system performance assessments, high productivity in terms of optimal use of resources and high availability of treatment are important for offering the right care at the right time for the population served by a healthcare system [17,18]. Improving these system-level productivity performance measurements, however, requires a more local focus on the continuous development of healthcare operations and on the reduction in errors, waste and variation to existing processes. These efforts have been addressed through quality-improvement methodologies such as Six Sigma and Total Quality Management (TQM) [19–23]. Evidently, improvement initiatives have been successful to some extent, but at the same time, the problems of increasing costs [4] and stagnant productivity development [3,8] call for alternative solutions for improving the throughput of patients at hospitals [13,19,23–26].

Previous research has demonstrated that improved hospital productivity can be achieved by directing a greater focus towards the flow of patients through healthcare organizations [8,11,24,26–35]. Improved hospital-patient flow do also have a positive impact on medical quality and the work environment [24,30,36,37], and has become a more outspoken policy priority [34]. Radnor

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et al. [24] and D'Andreamatteo et al. [26] highlighted that the last two decades have seen a plethora of healthcare improvement projects, specifically so-called lean implementations focusing on how to break process barriers and improve the flow of patients. Multiple promising solutions have come from these projects, yet these projects rarely encompass entire hospitals to cover the complete patient process from admission through discharge [26,29,34]. Another promising area for patient flow improvements are projects on clinical patient pathways that seek to, from the bottom up, define and improve the patient flow across the healthcare system for certain well-defined groups of patients [38,39]. Projects on patient pathways do however not take a holistic grip on hospital-wide patient flows as they are restricted to a small number of well-defined patient groups, and consequently, there is a great risk of suboptimization.

A hospital-wide and comprehensive perspective of the myriads of emergent and planned patient flows across a hospital organization is, thereby, seldom addressed, resulting in suboptimizations and process deficiencies along patients' hospital journeys [13,28,31,34,40]. Recognizing a system approach to studying the interaction among system parts across the hospital patient process can offer new possibilities for improving both the hospital-wide patient flow and the health of the population through better healthcare access [29,31].

According to Devaraj et al. [32], research on process improvements at hospitals points to the need to understand the constraints to a process as a means of improving it. This offers possibilities to identify and describe bottlenecks in the system before breaking them [41,42]. This is further articulated by the law of bottlenecks stating that the overall efficiency of a process can only be improved by addressing its major bottlenecks or constraints [31,42,43]. Therefore, research on how to improve hospital productivity by streamlining the hospital-wide patient flow must start by exploring and understanding barriers and associated root causes of hospital-wide patient processes [29,31,37,44].

The flourishing interest in how to improve hospital patient flows has inspired publications of several literature reviews putting empirical findings into system-wide perspectives. D'Andreamatteo et al. [26] explored patient flows from a lean perspective; Vos et al. [44] described organization-wide process-oriented hospitals; and Gualandi et al. [34] identified actions, actors, and enablers for improving the hospital patient flow. All of these researchers touched upon barriers that prevent swift and even hospital-wide patient flows, but none gives a systematic and complete picture of the existing research. Moreover, Villa et al. [29] developed a framework to analyze hospital-wide patient throughput performance, starting with the exploration of patient flow barriers and resulting in six different main causes of patient flow problems. Even so, the review on throughput barriers is rather minimal and does not give a comprehensive overview of the literature.

Hence, to the best of our knowledge, no comprehensive or systematic literature review of studies analyzing hospital-wide patient process throughput barriers has, thus far, been undertaken. To address this knowledge gap, we conducted a systematic literature review by consolidating the substantial body of studies from single hospital settings, synthesizing their results, and finally aggregating them into a hospital-wide perspective. Therefore, the aim of this article is (i) to explore existing research on what factors are preventing swift and even patient throughput at hospitals and (ii) to synthesize those factors into themes, main barriers and underlying root causes.

1.1. The theoretical framework

The theory of swift and even flows (TSEF) presented by Schmenner and Swink [42] describes that the roots of productivity innovation lie in improving throughput time and reducing variation. The potential from directing TSEF to health care can be derived from a need to enable an efficient patient throughput along the processes within a healthcare organization [32]. Process theory, developed by Holweg et al. [41], further explains that all operations are composed of processes operating together, and that a set of suboptimal solutions can never produce a global optimum. This perspective is often missing in health care as process improvements are, to a large extent, implemented only on a functional level (i.e. single units or clinics) and not on a systemic level [13,29,31]. Holweg et al. [41] presented a conceptual model providing a framework for analyzing process barriers. The process model, as illustrated in Fig. 1, comprises four categories: **inputs** (*resources*), **outputs** (*products*), **transformation** (*conversion of resources to products*), and **management system** (*management and control of the processes*). Of these four categories, transformation can be further divided into two sub-components: **internal sub-processes** (internal *activities of converting resources to produced goods*) and **transfer** (*movement of goods between internal activities*).

The hospital patient process could be described using these categories, although knowing that the theory has not been developed for a flow of patients or for the healthcare sector potentially reduces its applicability. With that said, using the described categories gives us: patients entering hospitals (*inputs*), and moves (*transfer*) between medical clinics (*internal sub-processes*), along a managed and controlled organization-wide system (*management system*), until discharge from the hospital (*output*). These categories of processes are used to further explore and understand the hospital patient process.

The productivity of a process depends on its throughput rate, defined as the actual rate at which output is made. Throughput rate is determined, according to Little's Law, by the throughput time of a process and the work-in-process, i.e. the amount of units worked on within a process [41,45]. In a hospital setting, work-in-process can be viewed as the number of patients within a hospital at a particular moment, where throughput time is the amount of time it takes for a patient to move from arrival/admission to discharge/departure at that hospital or medical clinic. Little's Law is, therefore, used to explain and categorize variables depending on what impact a variable has on the throughput of a process.

According to Glouberman and Mintzberg [46], healthcare processes at hospitals are complex and comprise multiple, interlocking sub-processes. In order to improve a process, it is crucial to map out and define it, i.e. to make it clear and manageable [47]. Today, however, it is not possible to find a common definition of what the patient process generally looks like at a hospital. Johnson and Capasso [12], Ben-Tovim et al. [48], Busby [49], Kolker [50] and Djanatliev and Meier [51] have all, independently of each other, defined and mapped out hospital patient processes. These maps are descriptive and serve certain purposes well but are incomplete in displaying the full picture of how a patient may move through a hospital organization. Therefore, we propose a new and more inclusive hospital-wide process model, as depicted in Fig. 2. The hospital process model is intended to be valid for medium-to-large-sized hospitals, encompassing both planned and acute processes as well as inpatient and outpatient perspectives. Thus, it depicts eight different settings: the emergency department (ED), the outpatient clinic, the operating room (OR), the intensive care unit (ICU), the pre-operative unit (Pre-OP), the post-aanaesthesianesthesia care unit (PACU), the inpatient wards and the radiology department. The internal patient process, the supporting radiological process and the external processes are also depicted in the model. Other ancillary processes such as lab services, material replenishment, medical delivery, etc. are not included since they involve a patient only indirectly. Finally, the five process categories have

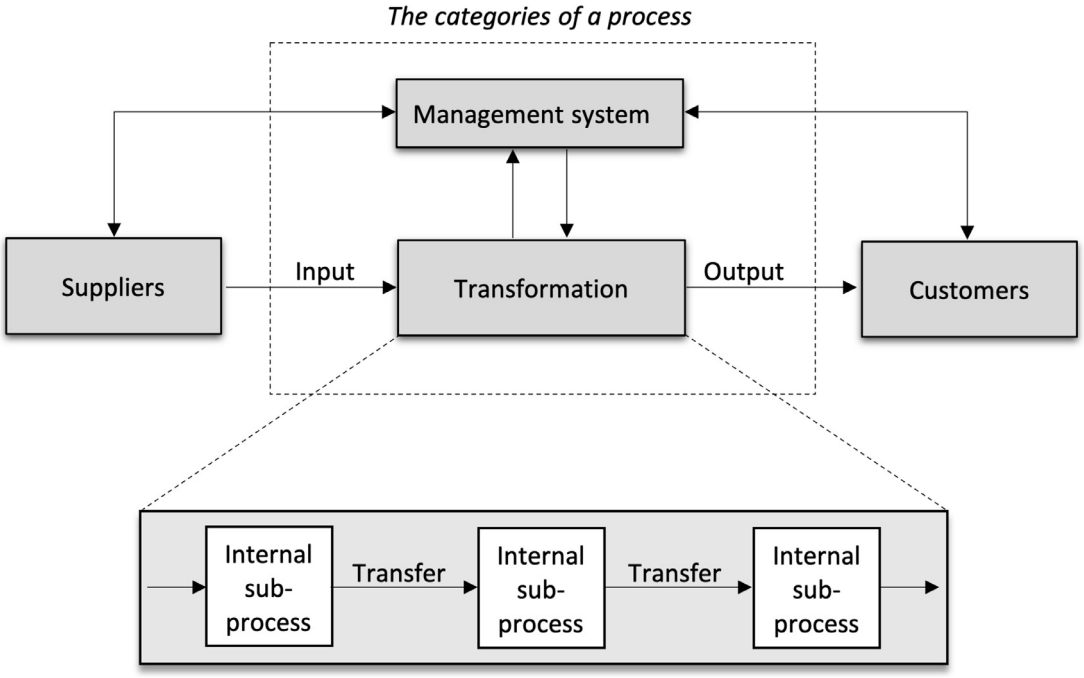

Fig. 1. Categories of processes, inspired by Holweg et al. [41].

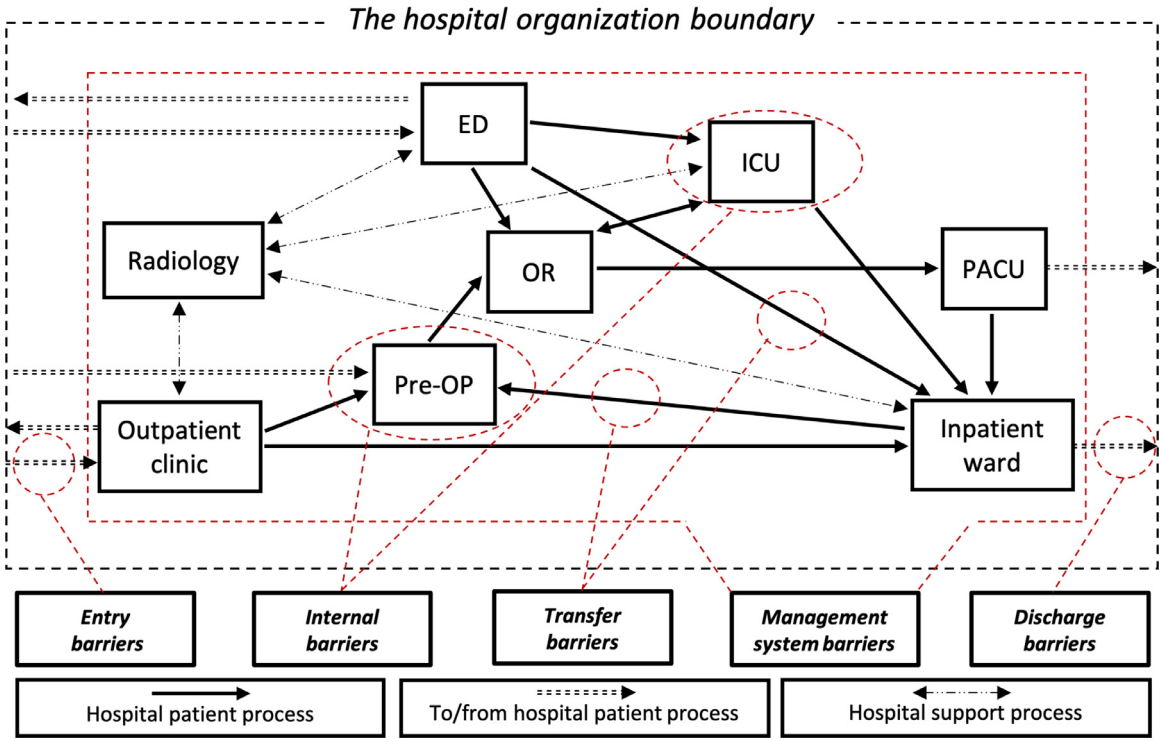

Fig. 2. The hospital-wide process model.

been partially renamed as inflow (*inputs*), outflow (*outputs*), internal (*internal sub-processes*), transfer and management system to recognize that it is a patient and not any object that moves through the process. The categories have then all been depicted in the model, oriented according to where their associated process barriers appear. This theoretically deduced process model serves as an analytical framework for analyzing and categorizing hospital-wide patient process barriers and their associated root causes.

2. Materials and methods

2.1. Search strategy

We conducted a systematic literature review following a procedure based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement by Moher et al. [52]. A database search was conducted in PubMed, Scopus and Web of Science screening for relevant English-language articles published

Table 1
Keyword search strategy & inclusion and exclusion criteria.

Database	Keyword Search
PubMed	("Hospitals"[Mesh] OR "Hospital"[tiab] OR "Hospitals"[*tiab*] AND (("Efficiency, Organizational"[Mesh] OR "Efficiency"[tiab] OR "Productivity"[*tiab*] AND (("Process Assessment, Health Care"[Mesh] OR "Organizational Innovation"[Mesh] OR "Product Line Management"[Mesh] OR "Hospital Restructuring"[M*esh*] OR ((Process[tiab] OR Processes[*tiab*] AND (flow[tiab] OR throughput[*tiab*]))))
Scopus	(TITLE-ABS-KEY (improv*) OR TITLE-ABS-KEY (develop*)) AND (TITLE-ABS-KEY(hospitals) OR TITLE-ABS-KEY (hospital)) AND (TITLE-ABS-KEY (organization * W/2 efficiency) OR TITLE-ABS-KEY (efficiency) OR TITLE-ABS-KEY (productivity)) AND (TITLE-ABS-KEY (process W/2 assessment) OR TITLE-ABS-KEY (organization* W/2 innovation) OR TITLE-ABS-KEY ("Product Line" W/2 management) OR TITLE-ABS-KEY (hospital W/2 restructuring) OR ((TITLE-ABS-KEY (process) OR TITLE-ABS-KEY (processes)) AND (TITLE-ABS-KEY (flow) OR TITLE-ABS-KEY (throughput))))
Web Of Science	(TS=lmprove* OR TS=Develop*) AND (TS=hospitals OR TS=hospital) AND ((TS= (organization* NEAR/2 efficiency) OR TS=efficiency OR TS=productivity) AND ((TS= (process NEAR/2 assessment) OR TS= (organization * NEAR/2 innovation) OR TS= (Product Line" NEAR/2 management) OR TS=(hospital NEAR/2 restructuring))) OR (TS= (process) OR TS=(processes)) AND (TS=(flow) OR TS=(throughput)))

Category	**Inclusion and Exclusion Criteria**
Inclusion Criteria	**The article must:** Contain an abstract; Be written in English; Be a qualitative or quantitative empirical primary study on patients receiving hospital care; Contain at least one description of a patient process related barrier; Have been published between 1st January 2010 and 1st November 2020
Exclusion Criteria	**The article has a focus on:** Primary care or care within a rehabilitation setting; Healthcare processes not relating to the hospital patient process; Description of theories, methods or models without empirical data; Editorials or policy statements without immediate empirical support; Literature reviews

between 1 January 2010 and 1 November 2020. This time span was selected to capture the most recent research from the last decade on patient process barriers at hospitals. Consequently, we began by identifying useful Medical Subject Headings (MeSH) and related free-text keywords for an initial search in PubMed. We finally settled on a combined keyword selection including various inflections of the words 'hospital', 'productivity', 'efficiency', 'process', and 'throughput'. This search string was then translated to Scopus and Web of Science, with the only exception being complementing the string with 'improv*' and 'develop*' to narrow down the assessment. See Table 1 for full keyword search.

2.2. Study selection and data extraction

After initial article assessments, we removed all duplicate articles, whereupon two rounds of screening were conducted. During this screening process, two of the authors, (PÅ) & (PA), read the assessed articles independently to eliminate subjective bias and errors. The authors have previous experience working with patient flows at hospitals (PÅ) and conducting research on healthcare productivity (PA), thus further reducing the risk of errors in the selection process. In the first round of screening, titles, keywords, and abstracts were read to make an initial selection. Generous early inclusion criteria were used, including every peer-reviewed article that related somewhat to the research aims. Thereafter, we excluded gray literature, proceedings, reports, and books. The remaining articles were then scrutinized in detail according to predefined inclusion and exclusion criteria (see Table 1), resulting in a highly relevant set of studies to be included in the review synthesis. Following this, we used a predefined extraction checklist to capture the most important characteristics of the assessed articles. These included the title, author(s), year of publication, country of study, hospital setting and study design. Finally, we extracted the number of beds at each hospital from their official websites, given that the name of the hospital had been outlined in the study, thus enabling a comparison of size and volume. For a full overview of extracted data, see Appendix A.

2.3. Synthesis strategy

A thematic synthesis methodology was used to achieve a consistent article analysis of the content and to identify central themes. In a thematic synthesis, articles are coded line-by-line as 'free codes', whereupon codes are aggregated based on their recurrence into descriptive themes. Finally, descriptive themes are developed as analytical themes to describe the particular phenomenon [53,54]. Accordingly, we coded each article and its content, focusing specifically on the patient process barriers each article had explored and highlighted. As most articles had explored root causes behind their identified patient process barriers, we established a link between them that indicated their interrelated causality. We then examined whether those root causes had been further explored by other articles. If that was the case, we once again established a link indicating the interrelated causality between the two barriers. The process of coding articles continued whereupon an increasing number of barriers and root causes were identified, and connections between barriers and root causes of each article, and between articles were established. As codes and links accumulated, a tree diagram for each setting evolved with multiple branches of barriers and root causes. Each branch was then connected to constructed descriptive categories based on the commonality between different branches in the tree diagrams. When the coding proceeded, multiple categories emerged within each tree diagram, i.e. for each hospital setting. To create a unified categorization across the settings, the previously mentioned categories were finally extracted and consolidated into a smaller number similar across all settings. These were finally renamed as 'main barriers'.

Next, we used the hospital-wide process model, Fig. 2, to sort the main barriers under the five themes of patient process barriers: 'entry', 'internal', 'transfer', 'management system' and 'discharge'. The number of main barriers connected to the theme '*internal*' became so high and so diverse that we had to consolidate those barriers into a smaller number. We decided to categorize them with inspiration from the three dimensions (through-

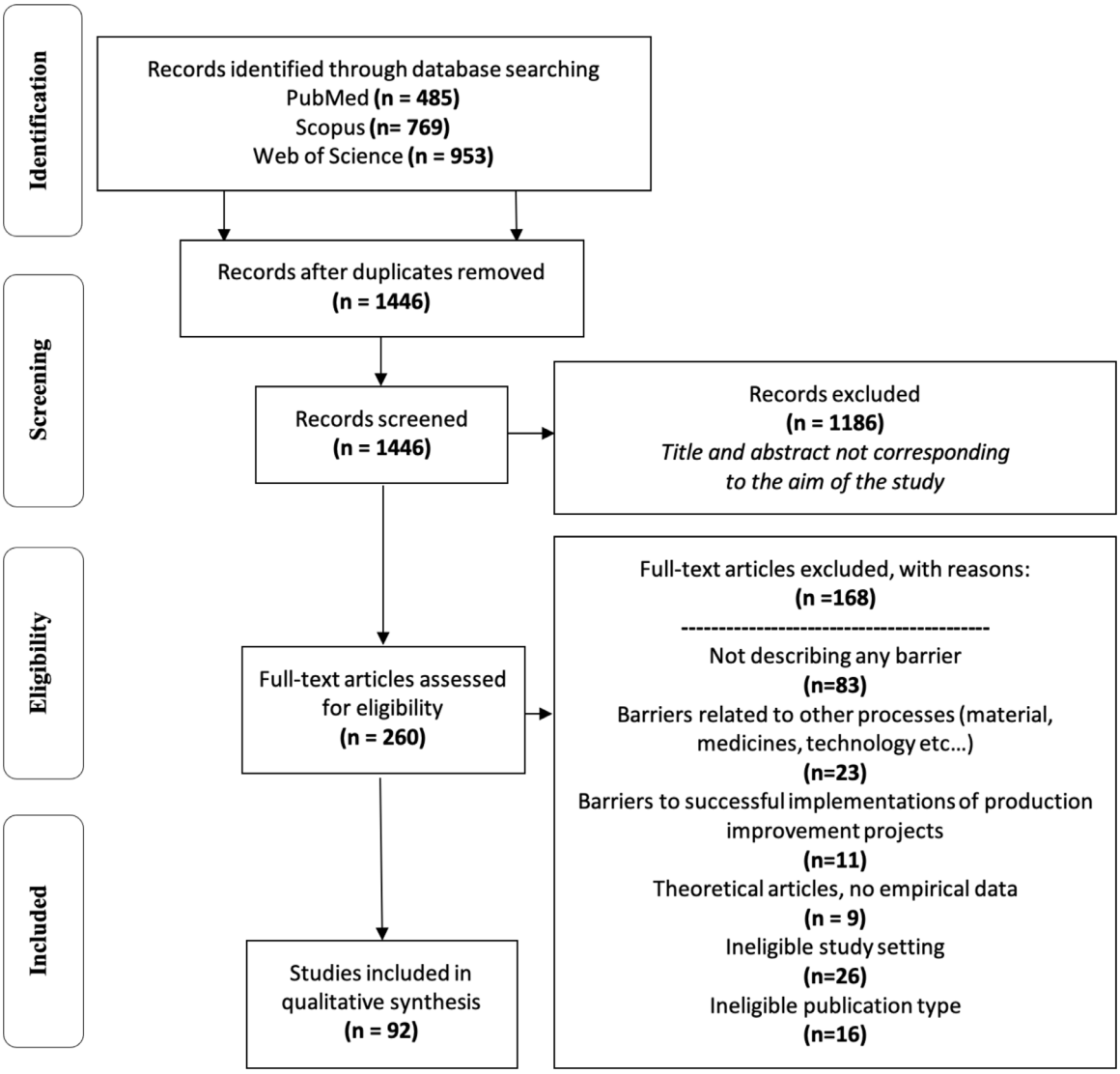

Fig. 3. The literature selection process.

put rate, lead time and work-in-process) of Little's Law. For a full overview of the tree diagrams structured according to the consolidated themes of main barriers, see Appendix B.

Following this, all identified root causes, i.e. the end nodes of all tree diagrams, were extracted. They were then categorized based on their similarity in description into central groups of root causes. As this sorting process continued, a hierarchy evolved based on the number of root causes consolidated under each group. We were finally satisfied with the consolidation process when, following the Pareto Principle [55], more than 80% of the initially identified root causes had been consolidated into a smaller number of unique groups, thereafter named 'main root causes'. To minimize bias throughout the synthesis process, a third author (CW) who had not previously taken part in the study selection process contributed to the thematization of barriers and root causes. For a full overview of the end nodes forming the main root causes, see Appendix C.

3. Results

Our review yielded a total of 2207 articles, 761 of which were duplicates, thus reaching a final number of 1446 articles. Of these, 260 articles were selected for a detailed review, and finally 92 key articles were included in the thematic synthesis. Fig. 3 depicts the full selection process of articles.

The data extraction shows that included studies have been conducted mostly in the ED, the OR, and the inpatient wards. This review has a broad international coverage, albeit with an overrepresentation in the US and Europe. Finally, hospitals of all sizes are represented, although with a concentration around 200–800 beds; see Appendix A. The barriers identified in the thematic synthesis are categorized with the help of the analytical framework into five themes, 12 main barriers and 15 main root causes; see Table 2. Table 2 also presents the total number of end-node root causes from the tree diagrams, connected to each main barrier, and separately, the total number of end nodes consolidated under each main root cause, depicting their presence and importance according to the included articles.

Of the five general themes, the theme *internal* stands out in terms of the number of main barriers and also in terms of associated end-node root causes; see Table 2. The most common barriers are long lead times, inefficient capacity coordination and inefficient patient process transfer and are linked to almost half of the total number of end-node root causes. Lack of staff, lack of standards and routines, insufficient operational planning and lack of IT functions are the most prevalent root causes of the identified barriers.

Table 2
Themes, main barriers, and main root causes.

Themes	Main barriers	# nodes	Main root causes	# nodes
Internal	Long lead times	42	Lack of staff	32
	Inefficient capacity coordination	40	Lack of standards and routines	20
	Insufficient capacity	28	Insufficient operational planning	19
	Large capacity utilization variation	16	Lack of IT functions	16
	Inefficient capacity utilization	15	Insufficient discharge routine	15
	High work in process	15	Insufficient facilities and layout	15
Transfer	Inefficient patient-transfer process	39	Insufficient communication	13
	Inefficient support-transfer process	15	Insufficient transfer coordination	12
Entry	Unpredictable inflow variation	15	Random internal disturbances	12
	Changing demand	8	Unpredictable patient problems	10
Discharge	Inefficient outflow process	8	Lack of beds	8
Management system	Low interorganizational coordination	7	Medical quality priorities	8
			Lack of ancillary services	8
			Increasing demand	6
			Lack of separate tracks	5
Total amount of root cause nodes		**248**		**199**

The main root causes are often similar among several main barriers. Fig. 4 visualizes connections between themes and barriers as well as interrelated causality between barriers and root causes.

The rest of the results section further presents the 12 main barriers identified in the literature review, following the order of Table 2. This section also highlights connections between barriers and root causes at different hospital settings based on where the specific barriers are most prevalent.

3.1. Long lead times

The time to start or finish a hospital activity (i.e. surgery, examinations, diagnostics, patient transfers, medical dispensation or laboratory services) affects a flow of patients across a hosptial. It will affect the lead time through a medical clinic and, consequently, the total lead time through a whole hospital from admission until discharge. As such, a vast number of studies find long lead times to be a decisive problem [30,56–86]. Long lead times at inpatient wards arise from delays in initiating the discharge process of discharge-ready patients [67,68,87,88]. This delay stems from various sources, such as prioritization of newer and sicker patients [12,87], missing preparatory paperwork for medical rounds [67,69,87], lack of medical and nursing staffing [69], lack of standards to prioritize from [68,73] and late starts of morning shifts [12,73]. Long lead times at wards may also be generated by a prolonged wait for medicines, prescriptions, follow-up meetings and discharge planning for discharge-ready patients [78,87,89–93]. This delay is, in turn, caused by a lack of coordination [91–93], insufficient medical storage layout [89,90] and a lack of physician staffing [73,91]. By contrast, long lead times at outpatient clinics are caused by late appointment start times [79,80,94] that result as a consequence of previous appointments not ending on time [79,80,94,95], delayed or absent patients [33,94,96] or delayed physicians [79,82].

3.2. Insufficient capacity

A lack in capacity cannot always be compensated for by innovative and efficient working methods. The capacity is simply insufficient. A factor hampering the patient flow and, not surprisingly, highlighted by multiple studies, is therefore insufficient capacity [56,65,67,71,74,79,92,97–106]. The patient flow through the ED is constrained by insufficient capacity [56,74,97,98,103,104,107–109] as a consequence of a lack of triage nurses and physicians [56,97,98,108], peak-time staffing resources [56,74,98,108], flow coordinators [104,109], medical scribes as support [74], pharmacists [110] and physician cubicles [56,74,108]. Other articles highlight slow diagnostic testing at the radiology department as a consequence of insufficient capacity [84,102,111,112], in turn a result of lack of digital diagnostic machines [84,102,111] or of staffing resources [102,112].

3.3. Inefficient capacity coordination

How available capacity at hospitals is utilized and how those resources (i.e. staff, beds, equipment, rooms, tools, time) are coordinated is given high importance, and several studies highlight inefficient capacity coordination as a major internal process barrier [30,57,64,69,76,87,92,93,96,97,110,113–128]. At the OR, inefficient capacity coordination is associated with an inefficiently planned operating schedule [121–125,129] as a consequence of a capacity mismatch with the existing demand [61,120], which in turn stems from a lack of capacity coordinators [121,129] and unrealistic resourcing forecasts [120,123,129]. The latter, in turn, are a result of surgery times not being based on characteristics of the individual patient or surgeon [61,123,129], the OR schedule not being designed to take into account the severity of cases [61,120,130] and insufficient capacity statistics when planning the operative schedule [64,123]. Finally, a lack of capacity statistics can be derived from a lack of standards [61,64,120] and high physician variability [61].

3.4. High capacity utilization variation

There seems to be inconsistency in capacity utilization at hospitals. Many articles consider high variation in capacity utilization as having a significant impact on the patient process flow [33,61,64–66,83,94,95,105,111,113,120,122,124,130–134]. At a preoperative unit, a varying capacity utilization is considered to result from late cancellations of surgeries [61,135], planned patient

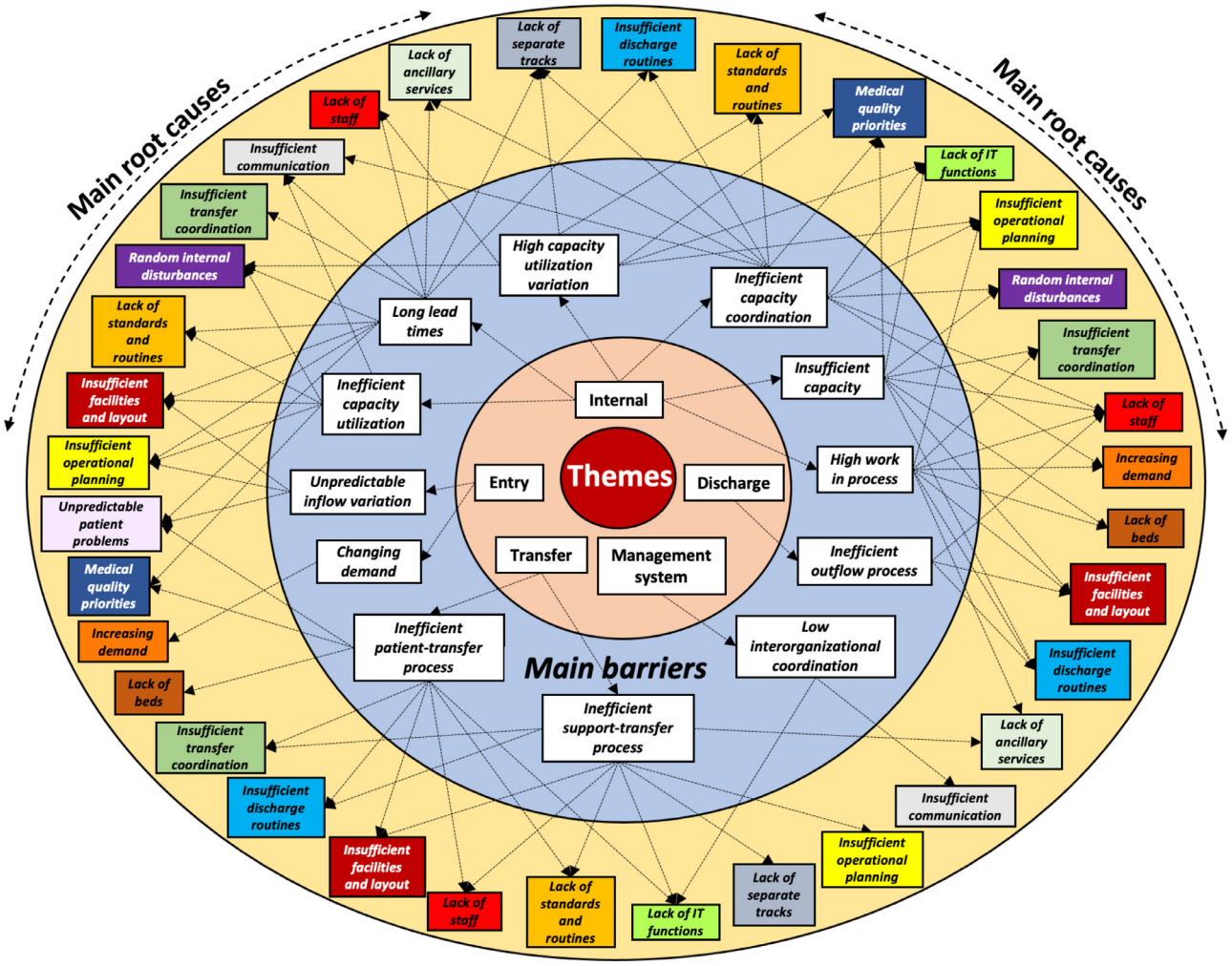

Fig. 4. The interrelated causality of themes, main barriers and main root causes.

flows disturbed by emergent cases [33,126], recurring capacity insufficiencies [33,120,126,134] and varying staffing capacity over the week [134]. This capacity variation is subsequently seen as a consequence of varying available staffing resources [64–66,121,134] and high variability in the patient caseload over the week [33,134], which in turn is a consequence of the pre-operative unit schedule not sufficiently accounting for the characteristics of patients or the required specific OR preparations [33,134].

3.5. Inefficient capacity utilization

Available capacity, whether sufficient or not, can be used more or less efficiently to ensure that an organization meets its objectives. Consequently, inefficient utilization of existing capacity is regarded as an important patient process barrier [57,59,61,62,66,68,81,83,85,89–91,93,96,98,103,104,108,112,114,121,129,130,136]. In the ED, inefficient capacity utilization can be found in the lack of split flows between more and less acute cases [56,103], the lack of using medical scribes to support physicians and nurses [74], in the slow patient-registration process [56], in the bottlenecks a triage waiting-room creates [107] and in the insufficient staffing at peak-time demand [56,74,98,108]. An inability to arrange split flows may then result from a lack of space [97] and the lack of peak-time staffing is connected to a complex and time-consuming triage process [59,97,98,107].

3.6. High work in process

If the number of patients staying or being treated within a hospital at the same time exceeds available capacity, queues and congestion build up and hamper the flow of patients. High work in process is consequently considered a barrier to prompt and timely processes [12,33,56,67,71,77,97,98,100,101,107–109,134,137–139]. At the inpatient ward, a high work in process builds up when too many patients are discharged at the same time [12,71,88], which stems from a lack of continuous patient discharge [12,88], discharge rounds given to all patients at the same time [88] or insufficient discharge preparation [71,74]. At pre-operative units, congestion builds in the morning before the start of the first surgery [33,120,134,135] as a result of multiple patients receiving anesthesia simultaneously [33,134,135], which in turn is related to multiple OR cases starting concurrently instead of having staggered start times [120,134].

3.7. Inefficient patient-transfer process

To transfer patients across a hospital and pass the responsibility for them from one medical clinic to another requires communication and clear routines, which are not always the case [56,58-60,65,66,81,97,104,115–117,120,128,132–134,137,140,141]. At the ICU, an inefficient patient-transfer process arises from patients who no longer require intensive care but are still in the ICU

[60,115], insufficient coordination with the ward [60,100,115,116], ICU staff being unable to reach accepting physicians at the inpatient ward [115,116] and unpredictable ICU discharge procedures [60,115]. That unpredictability is subsequently linked to a lack of routines and checklists [60,100,115] and to physicians making inconsistent judgements (115).

3.8. Inefficient support-transfer process

At hospitals, there are several supporting processes, i.e. ancillary services, for the main production process. Process barriers associated with a transfer of patients between patient-responsible clinics and ancillary services are highlighted by several studies [74,85,91,97,98,102,107,119,127,137,138,142,143]. Inefficient support-process transfers are found in delayed patient transfers between the ED and radiology department [102,137,138,142,143], long radiology turnover times [84,101,102,111], the lack of dedicated radiology porters [102] and in the difficulty patients have finding the radiology department and the correct treatment room [85,143]. At the inpatient ward, this transfer inefficiency can be found in the long lead times in ancillary services [87,91,102] associated with insufficient ancillary resources [72,102] and the lab or radiology services not prioritizing discharge-ready patients [87]. Inefficient transfers may also result from ordering lab and radiology tests on too short a notice [69,87,88], insufficient discharge routines [87,88] and a lack of resources and time at the ward [89].

3.9. Unpredictable inflow variation

Multiple studies highlight challenges with unpredictable variation caused by patients not complying with booking agreements or arriving with unexpected complications [33,64,66,82,88,96,121,129,132,134,135,144]. This can be related to patients' unknown and unexpected comorbidities when preparing for surgery [132,134] or to patient 'no-shows' for both surgery and outpatient appointments [33,61,66,88,96,121,134,144]; these may result from patients' medical conditions being too severe [129,132], patients' low ability to influence the day of surgery or of an appointment [*129*], health care being taken for granted (96) and physicians not conducting a sufficient pre-operative assessment before surgery [61,88,121,129].

3.10. Changing demand

The ED and outpatient receptions, as hospital gatekeepers, are both directly affected by changes in the demand for health care. The fluctuation in type, number and variety of patients is considered challenging [56,74,95,97,101,105,106,109]. This changing demand is partly associated with a general increase in patients requesting health care [56,95,97,101,106], which is related to an aging population [56,109], an increase in the number of patients with multiple chronic diseases [69,109] and reduced access to primary-care services [56,109]. Another source of changing demand is related to significant fluctuations in incoming medical referrals from primary care [95,105,106], which is caused by seasonal variability in referral volume [95,105] and insufficient dialogues with GPs in primary care [105].

3.11. Inefficient outflow process

Transferring a patient and handing over the responsibility for that patient's care from the hospital to an external provider imposes a significant challenge to healthcare organizations [30,69–73,78,87,88,91,97,139]. At the inpatient ward, an inefficient outflow process is caused by insufficient access to transit or discharge areas [69,88,91], an inability to discharge patients during weekends [30], transfer delays to external providers such as nursing homes [73,76–78,91] and external care providers not being ready for patient transfers [30,87,97]. This lack of readiness is associated with late internal discharge planning [67,73,87], external providers accepting admittance only on weekday mornings [97] and a shortage of care facilities for aging patients [30,97].

3.12. Low interorganizational coordination

Across the hospital organization, interrelated actors need to coordinate with each other to improve the global chain of events. Patient process barriers associated with the management, however, have not been widely explored but are still highlighted by some studies [67,76,86–88,139,143]. At the inpatient ward, low interorganizational coordination can be seen in a slow bed turnover [12,67,76,87], which is associated with a lack of accurate and timely discharge notification [76], insufficient communication with the ED [76,87] and ineffective data management [12,67]. This can also be seen when the inpatient ward cannot prepare for surges in demand for acute care [12,67,88,139], associated with a lack of accessible patient flow status (69, 88, 139) and when the ward cannot track real-time occupancy rates in the ED, ICU or OR [12,88].

4. Discussion

Improving hospital patient flows as a means of improving productivity requires a hospital-wide approach (24, 29, 31, 34). Moreover, improving the overall performance of a process can be achieved only by identifying and solving its main constraints (42, 43). Hence, in the search for a scapegoat to hospital-wide patient throughput problems, our review reveals the complexity behind patient processes at hospitals and that barriers and associated root causes are intertwined and must be addressed as such. In all, 12 main barriers and 15 main root causes have been identified, providing a good point of departure for policymakers and healthcare managers on which bottlenecks to really focus on. The categorization also provides a context to the root causes in terms of connected types of barriers and themes based on type of setting across a hospital-wide patient process. This offers improvement agents further possibilities to identify the most-appropriate improvement strategy according to a specific hospital's policies or objectives. The identified barriers are also confirmed by other hospital-wide studies that highlight *long lead times* [11,12,24,47], *inefficient capacity coordination* [12,46] and *inefficient patient-transfer processes* [26,29,47] as important aspects. Moreover, Villa et al. [29] associates inefficient patient flows to poor allocation of capacity, shortage of capacity, high variability, lack of coordination, presence of bottlenecks along the patient process, and overlaps between elective and emergent cases. Comparing this to our review, this study presents insufficient capacity as one of the identified main barriers, which can result from both insufficient resources (lack of beds and IT functions) and an inefficient use of resources (insufficient discharge routines and transfer coordination). Additionally, inefficient capacity coordination, another identified main barrier, can precisely like insufficient capacity be the result of resource insufficiency (lack of staff and IT functions), or an inefficient use of resources (insufficient standards, routines and communication). This example demonstrates how different throughput barriers can be the consequence of similar root causes as well as how barriers and their associated root causes are intertwined. This review confirms aspects highlighted by previous literature but extends the analysis significantly by ordering barriers in new levels to better explain the complexity behind inefficient hospital patient process throughput.

There is an ongoing discussion on what policymakers should do to improve the financial situation in health care as expenditures

keep increasing [3,4]. Another debate revolves around whether policymakers should focus on strategies of cost containment or production improvement [8–10] and whether production improvements can be reached with or without increasing the amount of available resources [11]. This review gives a broad overview of existing literature on patient throughput processes. The identified root causes of the main process barriers consist of several factors where *lack of staff, lack of standards and routines, insufficient operational planning* and *lack of IT functions* are the most prevalent. Together, they indicate that root causes of inefficient hospital patient throughput are both resource-related and work-method-related. The potential of examining work methods to improve patient flow can be compared to *lack of staff* being virtually the only factor that is heard in public debates. This can be seen in debate articles where unions, professional organizations and hospital management, as well as politicians, are arguing for more resources to solve capacity problems [5,145–148]. Even though a lack of resources is a relevant factor, our results indicate that there are several other root causes that are more easily addressed and can lead to capacity improvements without increasing expenditures, a strategy also supported by previous research. Meeting rising healthcare demands with a focus on increasing resources has, in fact, been attempted multiple times over recent decades with consequences of high cost increases and, rarely, equivalent gains in capacity [8,11,29,35,37]. Lastly, recent studies highlight the acute need to use existing resources more wisely as lack of staff is projected to rise significantly in the coming decade [5,146].

Improving hospital performance is not an easy task for policymakers. To address it, a hospital-wide framework has been developed comprising two models. By using the hospital-wide process model (Fig. 2) in combination with the barrier causality model (Fig. 4), it is possible to take different paths based on the unique situation of each hospital. The strength lies in understanding the broader patient process barriers and connections to multiple similar root causes. Using this framework will make it possible to approach an improvement strategy by focusing on a specific setting and, from there, to address associated barriers and root causes. It will also be possible to take the opposite approach by focusing on a specific root cause for addressing multiple barriers. The two models are bi-directional and can, therefore, together serve as a framework for guiding improvement activities, no matter the starting point. Analyzing barriers behind inefficient hospital-wide patient flow can be found in a few previous studies with a focus on performance indicators [29], paradoxes of patient flow [31], applications of lean healthcare production [26] and general improvement strategies [34]. The comprehensive framework evolving from our systematic literature review complements their work by enabling a deeper understanding of hospital-wide patient process barriers in various contexts and from various perspectives.

Hospitals are organizations that consist of multiple interlocking sub-processes and complex change dynamics, with strong professional structures sharing different views on how to improve the healthcare sector [46]. Hospitals struggle from conflicting logics between professional and administrative or political groups where healthcare professionals see the needs of the individual patient while the other groups are advocates for the society or the future patient [149,150]. This complexity adds ethical stress to all those working along the patient flow [151]. Moreover, the behavior of or the influence from patients themselves in the treatment process has a profound impact on throughput. This can be seen in patients' willingness or capacity to comply with the process of care and with the decisions made by healthcare professionals. All these perspectives provide significant challenges to coordinate all the actors across the value chain and, thereby, enable a seamless patient process along the whole trajectory of care [8,27,34]. A system approach might then provide better possibilities for reaching common ground in development projects. Kreindler [31], and D'Andreamatteo [26] also emphasize difficulties in improving the patient flow across hospitals without taking the system-wide approach. They argue that successful local flow improvements in the best case scenario offer local optimization and, in the worst case, risk impairing the patient flow of adjacent clinics or units. An overall organizational strategy to improve hospital patient flows is, therefore, needed.

To support hospitals in designing system-wide improvement strategies, researchers must conduct more studies using a broader lens. Understanding how to improve the hospital-wide patient process is troublesome today as previous research on patient process barriers has focused almost entirely on single medical settings (clinics or units). This literature review demonstrates the strong focus on single settings, seen in the dominance of barriers and root causes associated with the internal theme. These barriers are mostly expressed from the need and objectives of a single setting and not from the need of a hospital or the system. By contrast, studies on process barriers in association with the management system are scarce and indicate that studying patient process throughput from a hospital-wide perspective is rare. This confirms previous research that has pointed to the scarcity of studies taking a hospital-wide perspective on patient process throughput [13,26,31,34]. Consequently, a lack of research on barriers in connection to the management system could mean that we overlook important reasons behind inefficient hospital patient throughput. This expresses a limitation to this study since a review is naturally limited to the included primary studies. To develop this framework further can, therefore, be achieved only by conducting further studies on patient process barriers associated with the management system.

This article contributes to decision-making by healthcare managers and policymakers by providing new insights into hospital-wide patient process barriers, filling a gap previous research has identified. In this study, two models have been built from the use of existing theory on processes, and applied in a novel context, adding to the existing body of knowledge. Using these two models, we have constructed a hospital-wide process framework connecting hospital settings with process categories and connecting those process categories with main barriers and their root causes. It extends the understanding and description of process barriers and their presence and impact on patient throughput at hospitals. The use of this framework also connects to a larger picture of healthcare system performance as it provides insights into how healthcare systems can reach their goals of timeliness, responsiveness and efficiency expressed by the WHO, the OECD and the IOM [15,17,18].

We believe that the greatest managerial contribution will evolve from the use improvement agents, and healthcare managers at hospitals, will have from this framework when designing their improvement strategies. Additionally, there is a decent body of knowledge to be found concerning patient process throughput at hospitals, but this study highlights a need for more hospital-wide research on the whole patient flow from admission through discharge. We also direct a focus to an exploration beyond internal process barriers to learn more about the whole ecosystem of processes at hospitals. Finally, this study has identified numerous main process barriers and their associated root causes related to hospital-wide patient process throughput. Hence, a natural subsequent step is to identify and evaluate sufficient solutions to break down these barriers in order to enable swift and even patient flows at hospitals.

This study comes with some limitations. Even though a rigorous method of systematic reviews has been followed, no quality assessment of included articles was conducted. The reason lies in the purpose of the study to capture all relevant research, enabling

a summative approach when identifying the main root causes. Hence, complementing the inclusion and exclusion criteria, the validity of the results has instead been derived from the large quantity of studies included in the review. Another potential limitation is the criterion of including only English-language studies, potentially excluding many important articles. Finally, to understand a whole system by uniting its parts does not guarantee a complete picture. There are, naturally, perspectives lost in this study. Even so, until large hospital-wide primary studies on patient throughput can be conducted, we will have to attempt to understand the whole by summarizing its parts.

5. Conclusions

This article has systematically selected and reviewed 92 papers on hospital patient throughput barriers. From the synthesis, 12 main barriers and 15 associated main root causes have been identified. *Long lead times, inefficient capacity coordination* and *inefficient patient process transfer* are the most prevalent patient process barriers at hospitals. These barriers are subsequently caused mainly by a *inadequate staffing, lack of standards and routines, insufficient operational planning*, and *a lack in IT functions*. This article has demonstrated the need for more hospital-wide primary research to further explore hospital-wide patient process barriers, as previous research generally has taken perspectives of the single medical clinic or unit. Finally, this study has developed a new hospital-wide framework to be used by policymakers, healthcare managers, and improvement agents when deciding upon what improvement strategies to follow in order to increase patient throughput at hospitals.

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Declaration of Competing Interest

The authors declare that they have no competing interests concerning the material discussed in this manuscript. This accounts for interests of either financial nature (such as grants, consultancies, equities, or other employments) or non-financial nature (such as professional, personal relationships or subjective beliefs).

CRediT authorship contribution statement

Philip Åhlin: Conceptualization, Writing – original draft, Methodology, Software, Data curation, Writing – review & editing. **Peter Almström:** Conceptualization, Methodology, Data curation, Writing – review & editing. **Carl Wänström:** Methodology, Writing – review & editing, Data curation.

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Supplementary materials

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Paper II

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Solutions for improved hospital-wide patient flows – a qualitative interview study of leading healthcare providers

Philip Åhlin*, Peter Almström and Carl Wänström

Abstract

Background Hospital productivity is of great importance for patients and public health to achieve better availability and health outcomes. Previous research demonstrates that improvements can be reached by directing more attention to the flow of patients. There is a significant body of literature on how to improve patient flows, but these research projects rarely encompass complete hospitals. Therefore, through interviews with senior managers at the world's leading hospitals, this study aims to identify effective solutions to enable swift patient flows across hospitals and develop a framework to guide improvements in hospital-wide patient flows.

Methods This study drew on qualitative data from interviews with 33 senior managers at 18 of the world's 25 leading hospitals, spread across nine countries. The interviews were conducted between June 2021 and November 2021 and transcribed verbatim. A thematic analysis followed, based on inductive reasoning to identify meaningful subjects and themes.

Results We have identified 50 solutions to efficient hospital-wide patient flows. They describe the importance for hospitals to align the organization; build a coordination and transfer structure; ensure physical capacity capabilities; develop standards, checklists, and routines; invest in digital and analytical tools; improve the management of operations; optimize capacity utilization and occupancy rates; and seek external solutions and policy changes. This study also presents a patient flow improvement framework to be used by healthcare managers, commissioners, and decision-makers when designing strategies to improve the delivery of healthcare services to meet the needs of patients.

Conclusions Hospitals must invest in new capabilities and technologies, implement new working methods, and build a patient flow-focused culture. It is also important to strategically look at the patient's whole trajectory of care as one unified flow that must be aligned and integrated between and across all actors, internally and externally. Hospitals need to both proactively and reactively optimize their capacity use around the patient flow to provide care for as many patients as possible and to spread the burden evenly across the organization.

Keywords Healthcare, Efficiency, Productivity, Process improvements, Organizational efficiency, Capacity utilization, Strategy, Hospital ranking

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Background

Demand for healthcare is rising faster than available capacity and is considered to be caused by changing demographics and increasing multi-morbidity [1, 2] in combination with chronic healthcare staffing shortages [3–7]. Simultaneously, healthcare systems annually

acquire larger portions of the national GDP, reducing the will of policymakers to continuously inject the financial support the sector requests [8–11]. Altogether, this causes prolonged waiting times for care, and the health sector's possibility to treat patients at the right time with the level of care they need is reduced [3, 7, 12, 13]. The need for improvement is urgent, especially in hospitals, the largest receiver of healthcare funding [14, 15]. Therefore, healthcare managers must look for new solutions to improve hospitals' capacity utilization to increase productivity without further increasing expenditures. The last two decades have seen a growing interest in how to improve healthcare productivity by focusing more on the patient flow, i.e. how to enable a higher throughput of patients through hospitals [12, 16–22]. Focusing on the flow of patients has been proven to decrease patients' length of stay (LoS) and increase the speed with which patients are processed toward discharge [13, 20, 23–25]. It may also help balance a varying number of patients along a continuum of care constrained by insufficient healthcare resources [22]. Additionally, a long LoS exposes patients to unnecessary risks of iatrogenic complications such as infections [21]. A greater focus on the patient flow is therefore recognized as critical to improve not only productivity but also medical quality, patient safety, and patient satisfaction [25, 26].

Many years back, Vissers et al. [27] and Litvak and Bisognano [28] highlighted the importance of using a system-wide lens when improving patient flows across hospitals. This perspective emphasizes the consideration of problems or bottlenecks associated with the flow of patients along a continuum of care throughout the organization [29]. It highlights that a plethora of clinics and medical units within hospitals, caring for the patient between admission and discharge, must align their objectives to make the hospital efficient and effective in delivering the right care at the right time and place and at the right cost [21, 22]. However, today this system-wide approach to patient flow is still mostly used rather superficially to denote merely that flow improvement requires intervention in more than one part of the system [29]. One explanation comes from the hardship healthcare managers face in employing a hospital-wide perspective on patient flows, as hospitals are internally divided, with departments and clinics not sharing the same objectives and often competing over common resources and the availability of various services [30–32]. Hence, studies on how to improve patient flow rarely encompass complete patient processes throughout the hospital, from admission until discharge [32, 33]. Instead, the focus is most often narrower, looking at the patient flow through single clinics or units [12, 22, 33]. In this light, recent research expresses the need for more studies on prescriptions to actually improve system-wide patient flows within hospitals. The research emphasizes the need for more evidence-based studies that can provide better guidelines to handle the contextual and causal complexities of the hospital associated with improving hospital-wide patient flows [12, 20, 22, 34, 35].

The aim of this study is, therefore to (i) identify effective solutions to achieve swift patient flows across hospital organizations and (ii) develop a framework to guide improvements in hospital-wide patient flows.

To address this aim, we have conducted an international interview study with senior managers at 18 large academic hospitals to explore how they perceive patient flows from a system-wide perspective and to understand their strategies on how to improve the flow across their organizations. Hospitals are acknowledged as highly complex organizations comprising strong professional groups with oftentimes different views on improving the healthcare sector [31, 32, 36]. Process improvement models originating from the industrial environment are therefore seldom easy to implement in healthcare organizations [32, 33]. Leading academic hospitals encompass the height of complexity within the healthcare sector, considering the significant number, variety, and complexity of patients they treat while fulfilling large teaching and research requirements. Consequently, they most likely face more obstacles and challenges compared to other hospitals when trying to improve their processes. Academic hospitals also generally achieve higher medical performance than other hospitals [37–39], presumably supported by leading practice in flow logistics, a connection found in previous research [25, 26]. The external requirements on these care providers to deliver high performance are also significant, as providers receive considerable funding from governments and public institutions for their research and teaching programs. Consequently, their solutions to swift hospital-wide patient flow should not only be specifically interesting but likely applicable to a wider range of other hospitals with less complex organizational structures. Moreover, representatives with a good understanding of the complete organization of the hospital and the various improvement projects conducted across the hospital are generally senior managers. They may not provide the same in-depth understanding as a large group of physicians or nurses spread across a healthcare organization. However, they do possess a holistic view of the problems facing hospitals and have relevant perspectives (from strategic to operative) when discussions are held at a more general level. Hence, senior managers at leading academic hospitals serve as study objects in this interview study on solutions to swift hospital-wide patient flows.

This paper builds on our previous study [40], a systematic literature review on what is preventing swift hospital-wide patent flows. According to Devaraj et al. [21], it is necessary to understand the constraints behind processes before trying to improve them. They point to the need to identify and describe the bottlenecks in a system before breaking them [41, 42], something further articulated by the law of bottlenecks, which states that the overall efficiency of a process can only be improved by addressing its major bottlenecks or constraints [29, 42, 43]. Consequently, based on the categories of processes presented by Holweg et al. [41], we developed a hospital-wide process model depicting five general themes of barriers patients moving through a hospital organization may face [40]. These are: Entry (the entry of patients to the hospital organization); Transfer (the movement of patients between clinics or departments); Internal (the treatment of patients within clinics or departments); Management system (the system-wide planning and control of the patient flow through the hospital); and Discharge (the exit of patients from the hospital organization), see Fig. 1. The model visualizes the patient process from admission to discharge through the central settings of a hospital organization, the patient processes to and from the hospital, and the supporting processes.

From our previous study, we have also developed a framework for what prevents the achievement of efficient patient flow across hospital organizations [40]. This framework describes 12 main barriers and 15 main root causes of inefficient patient flow categorized under the five previously described themes of barriers; see Table 1. This framework acts as a starting point, and in this study, we connect barriers with solutions to provide healthcare managers, commissioners, and decision-makers with an extended framework consisting of both barriers and solutions to swift hospital-wide patient flows.

Methods

Design

We have taken an explorative qualitative approach throughout this study, encompassing both deductive and inductive elements. A deductive methodological framing has been used, taking previous research as a starting point to extend a framework for efficient hospital-wide patient flows, presented by Åhlin et al. [40], with new perspectives. The framework has shaped the data collection method and understanding among researchers of

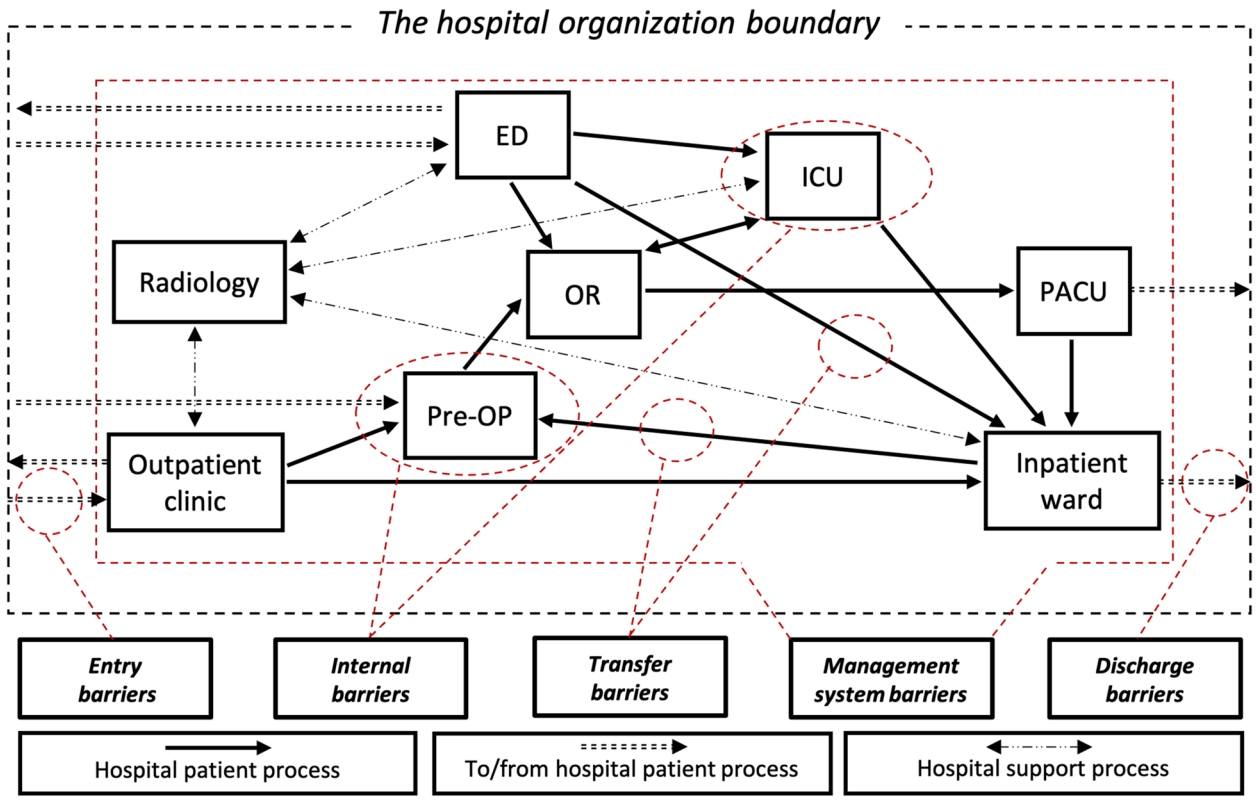

Fig. 1 The hospital-wide process model, Åhlin et al., [40]

Table 1 Themes, barriers, and root causes of inefficient patient processes

Themes	Barriers	Root causes	
Internal	High work in process	Increasing demand	Lack of IT functions
	Inefficient capacity coordination	Insufficient communication	Lack of separate tracks
	Inefficient capacity utilization	Insufficient discharge routine	Lack of staff
	Insufficient capacity	Insufficient facilities and layout	Lack of standards and routines
	Large capacity utilization variation	Insufficient operational planning	Medical quality priorities
	Long lead times	Insufficient transfer coordination	Random internal disturbances
Transfer	Inefficient patient-transfer process	Lack of ancillary services	Unpredictable patient problems
	Inefficient support-transfer process	Lack of beds	
Entry	Changing demand		
	Unpredictable inflow variation		
Discharge	Inefficient outflow process		
Management system	Low interorganizational coordination		

the problems the study objects face. A thematic analysis of the collected data has, however, also been conducted with a clear inductive research approach, chosen to carefully explore the subjective views of the study objects, as suggested by Braun and Clarke [44] and Dixon-Woods et al. [45]. This has been chosen instead of, based on prior research, looking for particular categories associated with the framework in a more deductive manner. Lastly, evolving themes from the thematic analysis were related back to the framework.

Data collection

In-depth, semi-structured interviews were used as a primary data source and together with the use of an interview guide, see Additional file 1: Appendix A, we ensured both comparability between interviews and openness to new ideas and perspectives [46]. Questions that guided the data collection throughout each interview were structured one by one to subsequently seek answers on how to best overcome each barrier described in the framework. When finding suitable participants, we used the 2020 international hospital ranking by the American magazine *Newsweek* [39], which presents an annual list of hospitals and medical clinics around the world based on recommendations from medical experts (doctors, hospital managers, healthcare professionals), results from patient surveys, and central medical KPIs. An initial inquiry was sent to the president or CEO of each hospital organization, whereupon the inquiry was often, but not always, forwarded to another manager better suited to answer our questions. If willing to participate, an online meeting was scheduled, and if the hospital found it appropriate, more than one participant took part in the interview. Consequently, the role of the participants varied slightly from the CEO or the president to the chief operating officer or the hospital medical director, and in a few cases, the flow department manager was interviewed. The selection criteria for participation were: senior managers with (i) responsibility for patient flow-related questions and (ii) a responsibility covering the whole or, at least, large parts of the hospital organization. Most participants had a professional background as physicians, a few were nurses, and a small number had a non-care related background. To improve the validity of the study, a pilot study was conducted with three regional hospitals in Sweden, whereafter each interview was transcribed verbatim and analyzed. The outcome slightly changed the interview guide and gave a better understanding of how to balance time between questions and formulate follow-up questions. Following the pilot study, the inquiry was sent to the 25 highest-ranked hospitals according to the list by *Newsweek* [39], and 18 hospitals accepted the invitation leading to a first interview, see Table 2.

Interviews were held with one or two managers, followed by a second interview when needed with either the same person(s) or another manager. Thirty interviews were held with, in total, 33 hospital managers, and only one manager later decided to withdraw participation, based on a retrospective judgement of not being the most suitable person to answer the questions. The interview guide was sent to every participant ahead of the interview, whereupon interviews were carried out by one of the authors (PÅ) between June 2021 and November 2021. Following the interview guide, each participant was asked what they and their hospital do to subsequently overcome each patient flow barrier. The main role of the interviewer was to enable an open and friendly format, introduce each subject, and then follow up actively with requests for further elaboration and clarification. The interviews lasted between 60 and 90 min, whereupon 11 of the interviews had to be extended with a complimentary session to get other person's views and to ensure that all questions were answered. The participants had different backgrounds and pre-understanding of the concepts discussed; therefore, some needed more prompting than others to appreciate all questions. All interviews were

Table 2 Interview study participant list

#	Hospital	Country	City	# Beds	1st Interview	2nd Interview	Ranking
Pilot study							
1	Region Hallands sjukhus	Sweden	Varberg	450	2021-05-02		N/A
2	Universitetssjukhuset Linköping	Sweden	Linköping	600	2021-05-17		3 (National)
3	Södra Älvsborgs sjukhus	Sweden	Borås	350	2021-05-24		18 (National)
Main study							
1	Mayo Clinic	USA	Rochester, MN	1,265	2021-06-30		1
2	Cleveland Clinic	USA	Cleveland, OH	1,285	2021-08-12	2021-09-20	2
3	Massachusetts General Hospital	USA	Boston, MA	1,011	2021-08-25		3
4	Toronto General (University Health Network)	Canada	Toronto	727	2021-09-15		4
5	Charité - Universitätsmedizin Berlin	Germany	Berlin	3,011	2021-09-27	2021-10-24	5
6	The Johns Hopkins Hospital	USA	Baltimore, MD	1,007	2021-07-02	2021-10-14	6
7	Sheba Medical Center	Israel	Ramat Gan	1,990	2021-08-31	2021-09-09	9
8	Karolinska Universitetssjukhuset	Sweden	Solna	1,340	2021-08-17	2021-08-20	10
9	Aarhus Universitetshospital	Denmark	Aarhus	1,150	2021-09-07		11
10	Centre Hospitalier Universitaire Vaudois	Switzerland	Lausanne	929	2021-06-29	2021-10-19	13
11	University of Michigan Hospitals - Michigan Medicine	USA	Ann Arbor, MI	1,006	2021-11-24	2021-11-25	15
12	Brigham and Women's Hospital	USA	Boston, MA	804	2021-06-28		17
13	Rigshospitalet - København	Denmark	Copenhagen	1,118	2021-08-13		19
14	Hospital Clínic de Barcelona	Spain	Barcelona	844	2021-08-05	2021-09-02	21
15	UCSF Medical Center	USA	San Francisco, CA	782	2021-08-30	2021-09-15	22
16	Les Hôpitaux Universitaires de Genève HUG - Cluse-Roseraie	Switzerland	Geneva	1,054	2021-09-27	2021-10-15	23
17	Sunnybrook Health Sciences Centre	Canada	Toronto	526	2021-10-26	2021-11-05	24
18	Helsingin Yliopistollinen Sairaala	Finland	Helsinki	2,546	2021-06-28		25

conducted online, using the online meeting software Zoom, as the COVID-19 pandemic prevented physical meetings.

Data analysis

All interviews were recorded and transcribed verbatim and sent back to respondents for approval. All authors read through and familiarized themselves with the transcriptions before thematizing the content to obtain a sense of the whole. One of the authors (PÅ) open-coded the verbatim transcripts, seeking to capture all expressed opinions and recommendations, enabling a vast number of unique aspects; see Additional file 2: Appendix B. Each aspect expressed a "solution" on how to overcome a particular barrier, and was consequently mapped to that barrier. This resulted in a large number of opinions and recommendations associated with at least one barrier of the framework. In a few cases, interviewees gave perspectives that did not address any pre-existing barrier of the framework. Hence, based on the interview material and discussions between (PÅ), (PA), and (CW), new barriers had to be constructed, whereupon these solutions were matched with the newly developed barriers. Following this, all open codes of solutions associated with one or several barrier(s) were discussed among all three researchers for aggregation into themes and higher levels of abstraction. This thematization ended when data saturation had been reached, no more solution categories could be identified, and consensus had been reached among the researchers.

Results

We present our findings from an overall observational perspective as well as from a deeper level with explanations of the underlying structures, supported by representative quotes from the interviews. The interviews yielded 558 unique opinions and recommendations, resulting in 50 solutions presented and indexed in Table 3. The right column in the table presents all solutions, and the middle column presents the barriers the solutions help to overcome. Lastly, the left column presents themes of barriers to visualize where along the patient flow these barriers evolve and, consequently, where the identified solutions provide support.

Table 3 Themes, barriers, and solutions to efficient patient flows

Themes	Barriers	Solutions
Entry	Changing demand	[s1] Strategic planning: make recurring strategic revisions on fit between demand and capacity
		[s2] Strategic planning: use predictive analytics to forecast demand patterns and capacity needs
	Unpredictable inflow variation	[s3] Cooperate with other hospitals to ensure bed capacity and to seek appropriate level of care
		[s4] Ensure capability to reroute less severe ED patients to outpatient, ambulatory or home care
		[s5] Reach, inform and treat patients before they seek acute hospital care
		[s6] Require increased primary care responsibility and support with more knowledge exchange and coordination
		[s7] Use IT-tools and data analysis for standardized admissions, early assessments and reduced no-shows
Healthcare sector	Unaligned and restrained healthcare system	[s8] Create healthcare system alignment with clear goals and objectives for each healthcare actor
		[s9] Increase staffing and bed capacity across the whole healthcare system[b]
Internal	High work in process	[s10] Optimize and smooth occupancy rate levels by admitting patients based on length of stay and ICU risk[c]
		[s11] Understand the tipping point of hospital's capacity utilization and ensure sufficient capacity buffers
		[s12] Use an OR block schedule per clinic and plan cases based on downstream bed availability[c]
	Inefficient capacity coordination[a]	[s13] Allocate dedicated capacity for both acute and elective patient flows
		[s14] Ensure a high OR-utilization with smart case mixes, all day utilization and quick cancellation refill
		[s15] Operational planning: have daily capacity meetings within the department or clinic
	Inefficient capacity utilization	[s16] Have a structured organization for daily problem solving and capacity optimization[d]
		[s17] Schedule staff and all clinical activities based on an optimal utilization of the OR-schedule
		[s18] Utilize as much of the week as possible and staff day and week according to real demand patterns
	Insufficient capacity[b]	[s19] Invest in ancillary service capabilites to minimize bottleneck risks in indirect patient activities
		[s20] Use external facilities or patient hotels to release hospital bed capacity
	Large capacity utilization variation[c]	[s21] Improve outpatient processes by implementing standards on schedules and appointments
		[s22] Improve prioritization schemes and develop standards on procedures, roles and staff ratios[a]
	Long lead times[d]	[s23] Make all employees understand the importance of having a patient flow focus[a, c]
		[s24] Give clinics trust and improvement autonomy but follow central process metrics and external benchmark
		[s25] Use more digital tools and new time saving treatment methods to reduce lead times
Management System	Insufficient patient flow focus	[s26] Connect managers and staff across the hospital to break silo mindsets
		[s27] Put patient flow focus on top of the agenda across the hospital, to change the culture
		[s28] Share and visualize correct data across the organization to make everyone understand flow implications
	Low interorganizational coordination	[s29] Align objectives, metrics and patient data systems (EHR & CRM) across the organization
		[s30] Increase collaboration on capacity between clinics and departments across the hospital
		[s31] Operational planning: have daily capacity meetings with all clinics of the hospital
		[s32] Use a flow command center to optimize capacity use and break hospital flow bottlenecks
		[s33] Use some type of patient coordinators to see and prioritize the needs and process of the patient
		[s34] Tactical planning: have weekly capacity coordination meetings with all clinics of the hospital
	Hospital wide capacity insufficiencies	[s35] Build up flexible hospital wide capacity to handle peaks or capacity unbalances
		[s36] Ensure sufficient capacity along the whole patient flow to avoid bottlenecks
		[s37] Use IT-tools to analyze bed capacity use and provide daily real time visibility on hospital capacity
Discharge	Inefficient outflow process	[s38] Have dedicated discharge coordinators or coordinating teams
		[s39] Improve the organization around discharge ready patients when planning procedures and activities
		[s40] Prioritize activities and organize staff to ensure early and efficient daily discharges
		[s41] Set early discharge goals and continuously work towards them for every patient
	Insufficient after care capacity and coordination	[s42] Enable discharge predictability with more home care solutions and own downstream facilities
		[s43] Provide follow up appointments at discharge to ensure accountability and continuity
		[s44] Request and work towards increased responsibility from after care services
		[s45] Share objectives, information and real time capacity data with after care services
		[s46] Use mutual staffing collaboration between the hospital and after care services
Transfer	Inefficient patient-transfer process and inefficient support-transfer process	[s47] Give a specific flow unit or team the task to control and arrange for efficient transfers
		[s48] Have standardized handoffs, pre-defined destinations and established incentives for efficient transfers
		[s49] Have clear roles with defined mandates concerning transfers between the ED and the receiving clinic
		[s50] Use digital tools to efficiently connect and navigate cleaners, porters, medical staff and patients

[a, b, c, d] refers to a connection between a solution and more than one barrier

To a large degree, Table 3 gives a unified picture among the hospitals of what challenges they meet and what solutions they seek or prioritize. On average, nine hospitals support or prioritize each solution; see Additional file 3: Appendix C. In Additional file 3: Appendix C, it is also possible to see that the prioritized solutions are evenly spread along the hospital patient process, addressing all themes of patient flow.

Beyond previously identified themes and barriers [40], one new theme and four new barriers were developed. We introduced the theme "*Healthcare sector*" together with the barrier "*Unaligned and restrained healthcare system*", as multiple hospitals point to problems in aligning different healthcare providers and to staff and bed insufficiencies across the healthcare system. Two barriers were introduced under the theme "*Management system*" to emphasize problems with a hospital culture not directed towards a flow perspective: *"Insufficient patient flow focus"*, and problems associated with capacity insufficiencies hurting the whole hospital and not just single clinics: "*Hospital-wide capacity insufficiencies*". Lastly, the barrier "*Insufficient aftercare capacity and coordination*" was introduced, as multiple problems are associated with the transfer of patients and the coordination and cooperation with aftercare services. This addition fills a gap, as few barriers have previously been found associated with the management system; the systematic review by Åhlin et al. [40] mainly included empirical studies of improvement projects in single settings. All themes, barriers, and solutions are presented in Table 3, with rows representing their connections. Superscripts in Table 3 indicate that one particular solution has a connection to more than the nearest barrier, within the same row.

The 50 solutions are explained below, together with representative quotes from the interviews under eight summarizing categories: 1. *Align the organization* describes the need to work towards a unified goal with a unified strategy throughout the whole organization; 2. *Build a coordination and transfer structure* describes the need to ensure quick and precise communication supported by clear mandates along the whole patient flow, from primary care to aftercare services; 3. *Ensure physical capacity capabilities* describes the need to create flexibility by investing in important spaces and places to enable greater buffer systems and peak census management; 4. *Develop standards, checklists, and routines* describes the need to make processes more clear and foreseeable to both patients and practitioners, as well as administrators; 5. *Invest in digital and analytical tools* describes the need to use available modern and smart IT services for quicker and better decisions; 6. *Improve the management of operations* describes the need to continuously assess capacity and optimize operations, both centrally and locally, to dissolve patient flow bottlenecks; 7. *Optimize capacity utilization and occupancy rates* describes the need to proactively plan activities to smooth resource utilization across the whole organization to make the organization more balanced and efficient; 8. *Seek external solutions and policy changes* describes the need to work towards a better-staffed, more patient-centric, and more aligned healthcare sector. To facilitate the reading, since the number of solutions is considerable, Table 4 visualizes the category in which each solution is presented.

Align the organization

Planning for an efficient flow along a patient's whole trajectory of care involves the need to approach heterogeneous clinical conditions, varying practices, routines, competing organizational objectives, and multiple local cultures. Therefore, the solutions [s23, s26, s27, s28, s29, s41] highlight the need to align the organization and address these challenges to improve the flow of patients. Several hospitals already consider it important to try to estimate the day of discharge upon patient admission and, if possible, have the entire organization focus on reaching that goal [s41]. To continuously improve this practice, statistical feedback loops are required to ensure precise estimations and enable root cause analyses behind potential deviations. This must also be supported by aligning the organization's objectives, metrics,

Table 4 Overview of the results section

Overview of structure of results section	Indexed solutions from table 3
Align the organization	[s23] [s26] [s27] [s28] [s29] [s41]
Build a coordination and transfer structure	[s33] [s30] [s38] [s43] [s45] [s46] [s47] [s48] [s49]
Ensure physical capacity capabilities	[s3] [s4] [s5] [s13] [s19] [s20] [s35] [s42]
Develop standards, checklists, and routines	[s21] [s22] [s24] [s39] [s40]
Invest in digital and analytical tools	[s2] [s7] [s25] [s37] [s50]
Improve the management of operations	[s15] [s16] [s31] [s32] [s34]
Optimize capacity utilization and occupancy rates	[s1] [s10] [s11] [s12] [s14] [s17] [s18] [s36]
Seek external solutions and policy changes	[s6] [s8] [s9] [s44]

and data systems to ensure that everyone shares the same view along a continuum of care [s29]. A patient flow focus within each clinic [s23] and across the hospital is important [s27], emphasizing the need for everyone to understand implications along the flow and take responsibility for the consequences of certain decisions, as described by this medical officer:

> *"If, for example, neurosurgeons have the goal to run neurosurgical care to the right quality and resource, then they are responsible for the final quality, waiting times, and costs along the entire flow until that patient is discharged. It is then likely that the heads of neurosurgery will need to spend 80 to 90 percent of their working time on activities outside of neurosurgery to strengthen them if they work poorly." - Medical Director, Karolinska Universitetssjukhuset*

Focusing on the patient flow highlights the importance of employees seeing the needs of the hospital and the whole population of patients along the patient flow before the needs of their own clinic or unit. Managers must also be committed to this change by building relationships and seeking cooperation across departmental borders to break silo mindsets [s26]. An open and collaborative culture must also build on shared visibility and transparency through correct data analyses [s28], as seen here:

> *"There are cultural difficulties, but if you can bring the data and show the correct numbers, things can improve. Before, people said, 'you do not have the right data because you say that I have six patients, but I have seven'. Shared visibility of what's really going on gives solidarity between departments like 'Oh, last weekend it was terrible for you, so I will give you some resources to cope with this influx of patients'. This is how you change the culture." - Deputy Director General, Les Hôpitaux Universitaires de Genève*

Build a coordination and transfer structure

Along the complex chain of events making up the patient flow, good coordination is needed between internal and external actors to align activities, handoffs, and transfers of patients [s33, s30, s38, s43, s45, s46, s47, s48, s49]. Efficient transfers between the ED and inpatient wards are supported by having specific flow units or teams in charge of both transfers and assignments of beds [s47]. Clear roles for everyone involved in transfer arrangements are also important, where the person or team in charge of transfers needs a strong mandate [s49]. Moreover, standardized handoffs, pre-defined destinations for patients with certain diagnoses, and clear incentives to promote efficient transfers are needed [s48], as highlighted by this senior vice president:

> *"We start to standardize the communication in referral pathways so that handoffs actually contain relevant clinical issues. It helps to prioritize how patients are admitted and to what services, so we don't spend as much time figuring out which services patients go to. Internally, we have also created a detailed admission document so that there's no delay once a clinical reason for admission has been established. It's all predetermined." - Senior Vice President, Massachusetts General Hospital*

Several hospitals emphasize the benefit of having specific patient coordinators to see the need of patients and plan care pathways to make them smooth and coordinated [s33]. It is also important to have case managers, social workers, coordination consultants, or discharge teams to proactively plan for a seamless and well-organized discharge process [s38]. Concerning the flow out from the hospital, a strong collaboration between hospitals and aftercare services and the presence of external staff to expedite the transfer of patients is recommended [s46]. Having nurses, physicians, and outgoing teams visit aftercare facilities also provides better alignment, and multiple hospitals point to the need to share objectives and information with aftercare services for better collaboration [s45]. Moreover, proactively planning for the continuous care of patients by providing follow-up appointments at discharge can further strengthen transfers and improve patient safety [s43]. Better coordination of patients and a stronger transfer structure are also supported by closer collaboration on the relocation of patients between departments and clinics [s30], exemplified by this medical officer:

> *"Instead of each unit operating as a silo, we have units operating together as pools of capacity, a medicine pool, surgical pool, cardiovascular pool. Multiple units can take the same type of patient for a larger overall capacity. Obviously, you need the right staff and skill for this flexible model, but that has allowed us to be more nimble." - Associate Chief Medical Officer, University of Michigan Hospitals*

Ensure physical capacity capabilities

Acting in a highly varying and often unpredictable environment requires flexible capacity capabilities that provide sufficient margins to avoid bottlenecks associated with overcrowding [s3, s4, s5, s13, s19, s20, s35, s42]. Hospitals must be able to reroute patients to avoid acute hospitalization, and internal command centres or flow teams can then provide good support. Clearly defined

pathways are needed from the ED to outpatient, ambulatory, or home care settings [s4] or to other hospitals or secondary care providers [s3]. Hospitals must also proactively reach, inform, and treat patients before they seek acute care by expanding the prehospital with mobile care teams, virtual EDs, 24–7 off-hours hotlines, and expanded telemedicine capacity [s5], as described by this general director:

> *"We are improving the prehospital, the organization running the ambulances. They have a great impact on the treatment of patients as their doctors in passenger cars sometimes arrive before ambulances. When people call 112, the prehospital ends about 10 percent of all cases. We constantly aim higher and ask if the next level could be 20 percent?"- CEO, Aarhus Universitethospital*

Several hospitals emphasize the need to build flexible hospital-wide capacities like floating nursing pools to handle peaks in demand and sudden capacity imbalances pointing to interim personnel units, multi-speciality wards, and short-stay units (SSU) [s35]. External facilities such as discharge lounges, patient hotels, and specific facilities for long-term transplant patients are also promising solutions [s20]. Some hospitals acknowledge the benefit of ensuring sufficient ancillary services capacity to avoid bottlenecks in direct patient activities [s19]. Having separate operating theatres for acute and planned surgeries is also helpful [s13]. Concerning the flow out from the hospital, some hospitals might consider opening aftercare services to ensure downstream bed capacity. A more common solution is to invest in home-care solutions for higher discharge predictability and to release bed capacity. However, this raises questions on how and where to care for patients and must be arranged with primary care and aftercare services. Lastly, home care is supported by in-home monitoring and using outgoing home care teams [s42]. This is described by one manager:

> *"We're opening a new telemedicine hospital called Sheba Beyond. So, if patients are not in critical care or prepared for the operation, they can go home. We can monitor them at home or at their nursing home. Our physicians, through telemedicine, can take care of the patient. The nursing home staff or the nursing staff from our hospital or the health care fund can go there and help, to prevent hospitalization. This is the new method we are working on. It is the future." - Associate Director General, Sheba Medical Center*

Develop standards, checklists, and routines

A myriad of activities is performed across the hospital every day by different people and in different manners. This creates significant internal variation and unpredictable patient processes. However, these can be mitigated by the introduction of more standards, prioritization schemes, and routines [s21, s22, s24, s39, s40]. Clarity of roles and procedures is emphasized concerning internal clinical activities like standards for nurse-bed ratios, work tasks, routes of communication, and decision-making [s22], as described by one medical director:

> *"Healthcare largely ignores time. An expectation is set on how many patients to see, but we don't have a good sense of the time it takes to see those patients. We don't necessarily know and account for the time it is to check those patients in, schedule their follow-up visits, or to make calls to transfer them to another unit. Part of the capacity problem is because we've ignored time. We need to get better visibility to that. How long does each step take and then staff to that."- Chief Improvement Officer, Cleveland Clinic*

Concerning clinical efficiency, several hospitals find it important to let clinics independently set goals and conduct improvement activities but then centrally follow up on performance measurements like the length of stay and bed and appointment utilization. Clinics are also compared against national benchmarks and internal capacity standards [s24]. Improving the processes of the outpatient clinics is also important, and standards are needed for schedules, clinical slots, and physician time [s21], as seen below:

> *"There is great variability in the ambulatory clinics' capacity utilization, depending primarily on the scheduling slots, both in time duration and numbers. Three years ago, we started a pilot project where everyone in a particular division had to agree upon and standardize their clinical slots, the length [of] time for each one, and start and end time. A part of it was that we wanted to go to electronic self-scheduling so that patients can schedule themselves." - Interim President, Brigham and Women's Hospital*

To improve discharge procedures, hospitals point to the need to introduce clear daily routines and prioritization schemes to ensure all necessary activities are synchronized and finished in time for early discharges [s40]. This must be supported by an organization-wide prioritization of the last steps for discharge-ready patients and that physicians prioritize discharge-ready patients more in relation to other activities [s39].

Invest in digital and analytical tools

Hospitals are complex, and acquiring a holistic view of the organization and its processes is hard. Therefore, a focus on digital and analytical tools is increasingly

emphasized for better and informed decisions and to provide technical support around the flow of patients [s2, s7, s25, s37, s50]. Moreover, hospitals are investing in predictive analytics to anticipate demand patterns, future needs for beds and staff, arising bottlenecks, organizational risks, and scenarios following strategic decisions [s2]. This is described by one medical officer:

> *"We've created an IT tool that takes our scheduled activity, translates it into a calendar, giving us visibility to the anticipated bed use each day, using modelling of length of stay profiles. We know tomorrow there's cardiac surgery patients using four ICU beds, based on historical use. The combined cardiac surgery service will use 30, and then we can say it's going to be these many future bed days. We then translate it into anticipated occupancy to see the consequences on ED boarding." - Associate Chief Medical Officer, University of Michigan Hospitals*

Concerning planned admissions of patients, digital tools become increasingly important when providing early video assessments or using robots and algorithms for automatic reading and sorting of referrals. Data analytics can also help standardise admission routines and reduce practice variability among physicians [s7]. Concerning capacity utilization across the hospital, demand heat mapping can be used to optimize the allocation of capacity, and real-time dashboards with relevant metrics improve the performance and control of operations [s37]. New technology can help digitalize radiology services and make patient flows and pathways more visual and transparent to both patients and staff [s25]. New IT systems can also quickly connect and direct providers and expedite the patient flow across the hospital [s50], as highlighted here:

> *"When we transfer patients, we visit our service platform and move them with one click from where they are to where they are going to be transferred. We then place an order in our control system for a porter to move the patient physically. Since we started to connect the system with the porters' telephones, they get quick information on what patient to bring where and at what time. It has immediately worked and been a real success." - CEO, Rigshospitalet København*

Improve the management of operations

How operations are executed requires good organization and efficient decision structures supported by clear communication channels to effectively manage available capacity [s15, s16, s31, s32, s34]. Multiple hospitals highlight a need for command centres to track and optimize daily capacity and to identify and act on arising bottlenecks [s32], as exemplified by one medical director:

> *"The concept behind the command centres is that we're trying to put all individuals responsible for the hospital operations in the same room, looking at the same data at the same time. We're using dashboards within our electronic health record to tell us in real-time what the situation is like in the ED, in the hospital, in the OR, and on the various floors. The data produced in our command center is then used as a template for our daily morning huddles and is driving decision making regarding where patients might go throughout our system." - Hospital Medical Director, Mayo Clinic*

To support command centres, it is important to have daily capacity meetings on anticipated admissions and discharges in combination with bed huddles at department levels [s15] and involvement of all clinics at the hospital level [s31]. A suggestion from several managers is to support these meetings with a weekly tactical capacity meeting to plan and settle disputes or misalignments [s34]. Additionally, it is important to have an internal structure for problem-solving supported by a continuous improvement culture, flow engineers, and a local operative management team [s16], as highlighted by this vice president:

> *"I am a Lean management fan, and we try to have a Lean daily management approach with huddles at the unit level, the OR level, and at the ED, where teams will at least, twice a shift, assess their capacity, throughput, and staff, cascading them up to say, where are there barriers?" - Executive Vice President, Johns Hopkins Hospital*

Optimize capacity utilization and occupancy rates

There must be a good fit between the demand a hospital is expected to serve and the available capacity and how that capacity is subsequently utilized [s1, s10, s11, s12, s14, s17, s18, s36]. Multiple managers highlight the need for recurring strategic revisions on evolving demand patterns followed by continuous adaptations on how the capacity is distributed to have correct sizes for each department [s1]. It is also important to anchor the goals of care production across the organization and base them on what each clinic and actor along the patient flow can achieve to avoid overcrowding and unnecessary bottlenecks [s36]. Furthermore, several hospitals point to the need for all healthcare managers and staff to understand the relationship between efficient flows and occupancy rates and the importance

of running below the efficiency tipping point to avoid harmful congestion [s11], as described here:

> *"When we improve our length of stay and our efficiency to get bed utilization down to 85 percent, we will undoubtedly have more demand. For example, we try to redirect some lower acuity patients but then we'll start saying yes to more complex patients, and we'll go back up to 90 percent again. If we then look at our occupancy rates, we can show that when we run above 88 percent, we lose efficiency. It creates a drag on the system. We lose degrees of freedom to move patients around, and it slows us down." - Executive Vice President, Johns Hopkins Hospital*

There are great possibilities to optimize and smooth occupancy rates across the hospital by forecasting and estimating patients' length of stay before settling on utilization plans for ORs, ICUs, and wards [s10]. To further increase predictability across operations, hospitals increasingly emphasize the need to level-load ORs with designated blocks per clinic, putting caps on the number of surgeries. This solution enables greater balance over the week and across services [s12], further explained by this patient flow director:

> *"Surgeons want to operate, so avoiding OR days on Mondays or Fridays, which tend to be holidays and get cancelled, makes sense. This leads, though, to low surgical volumes on weekends and Mondays, building on Tuesdays, and potential cancellations due to high volumes on Wednesday and Thursday. This is hard on the staff and creates stress trying to get all surgeries through. We shifted to a goal that every day, there is a smoothing target by the type of surgery or units that patients will go to. When we now schedule, we proactively set targets, saying, 'you can do five a day, and that's it. You can't go over'. That's been very effective in managing surgical flow." - Director, Patient Flow, Toronto General Hospital*

Ensuring high utilization of the OR capacity can come from better utilization of OR days, smart mixing between short and long cases, filling the schedule from the back, and having a pool of patients for quick cancellation refills [s14]. It can also come from better long-term planning of OR schedules and surgeons prioritizing surgeries before other activities [s17]. Increasingly, pressuring demand patterns also force hospitals to better utilize the working week by introducing more flexible staffing schedules outside traditional hours to handle both present demand and sudden peaks [s18].

Seek external solutions and policy changes

No matter how efficient internal operations become, an organization is always dependent on the wider system it belongs to for overall efficiency, and there is a need for better alignment and increased capacity across the healthcare system [s6, s8, s9, s44]. Concerning primary care, hospitals find themselves treating and caring for patients that would be better served by primary care providers and point to solutions of extended primary and urgent care presence with longer opening hours, closer hospital collaboration, and dedicated specialist-led education of general physicians [s6]. Many hospitals also find themselves squeezed between a never-ending inflow of patients and difficulties in finding aftercare providers willing to accept discharge-ready patients. The question is whose responsibility it is to care for discharge-ready patients where improved transfers may come from increased downstream bed capacity, changed legislation, or new incentive programs [s44], something seen in this interview:

> *"The one who sets the agenda for when we can send a patient is the external actor. It's not us. We can kindly stand with the hat in hand and ask, 'could you maybe take this patient?' where the answer is, 'no, we cannot; we can on Monday'. We have regional and municipal healthcare with too many principals, different politicians, and budgets, and they push costs on each other. It's a huge concern when it's the same patient flow, and there is a lack of common goals between these actors with regards to patient flow." - Medical Director, Karolinska Universitetssjukhuset*

This all boils down to a need for more patient-centric care and alignment of all care providers across the healthcare system with clear task descriptions, common patient goals, and policymakers focused on transforming the system [s8]. Most hospitals also acknowledge the chronic staffing shortages in the healthcare sector and emphasize the need to increase human resources across all actors. The scapegoat for much flow inefficiency is simply insufficient staffing [s9], as explained below by one medical director:

> *"Another real barrier that we are facing in many places is staffing shortages. In many cases, we've designed the system with the right amount of capacity to support the care, but we often cannot staff to our plan, and we struggle to anticipate demand." - Chief Improvement Officer, Cleveland Clinic*

Discussion

There is a great need for improved hospital productivity to meet the challenges of future healthcare demand, and previous research shows that more focus on patient flow can help increase hospital productivity [12, 20, 21, 26]. The system-wide perspective is increasingly emphasized as patients move between multiple professionals, clinics, and administrative units along their trajectory of care [20, 22, 29, 33, 34]. We present 50 solutions, taking a system-wide perspective on what hospitals can do to enable swifter patient flows across their organizations. Our findings show that multiple professional, cultural, managerial, technical, and political aspects must be addressed and that a holistic strategy covering patients' whole trajectory of care is needed. The presented categories of solutions can be found in previous research concerning parts of the hospital patient flow, as needed developments, or as implemented interventions. The need for "*better organizational alignment*" is highlighted by several studies [29, 34, 36, 47, 48] to make the organization process-oriented [34] and better integrated with clear organizational goals [36]. Having *"better coordination and transfer structures"* has been identified [12, 20, 22, 31, 34], highlighting the need to have patient flow managers with strong mandates [20] and central patient and transfer coordinators [22]. *"Increased physical capacity capabilities"* [16, 19, 49], like increased investments in ancillary services [16] and the expansion of home care services [49], are important. Several studies also confirm the need for *"more standards, checklists and routines"* [20, 22, 25, 32, 33, 50] to enable more efficient capacity utilization [20] and to reduce lead times and improve medical outcomes [50]. The need for *"more digital and analytical tools"* has been found [12, 20, 21, 26] to give support to the scheduling, diagnosing, and coordination of care [21] and enable real-time data visibility [26]. Other researchers have uncovered the need for *"better management of operations"* [9, 26, 32, 50], including centralization around a patient flow management centre [26] and a stronger focus on continuous improvements [32]. Moreover, several researchers confirm the *"need for capacity optimization and occupancy rate balancing"* [7, 19, 20, 51], like smoothing the surgical schedule [19] and better predictions and avoidance of disaster-level overcrowding [7]. Lastly, previous research emphasizes the need to *"seek external solutions and policy changes"* [4, 22, 29, 34] to create more integrated healthcare systems [29] and make policymakers and politicians understand the arising staffing crisis [4].

Despite the complexity of being large academic hospitals, these hospitals succeed in implementing several of the highlighted solutions. Previous research points to top management support, one of the most important factors in successfully implementing change [22, 52, 53], as one likely explanation. We cannot, from our study, establish this direct link, but it is worth noticing that these interviews only involved senior managers. Consequently, having a top manager working with flow-related questions, and holding a holistic view of the hospital-wide patient process, likely provides important support to commissioners when improving the flow of patients. These hospitals also strategically plan their activities and improvement projects from a hospital-wide perspective, something previous research indicates is often missing [32, 33, 47]. Moreover, these hospitals are considered leading because of excellent medical performance and patient satisfaction [39], which previous research has found to be supported by swift patient flows and short lead times [21, 26].

There is an ongoing debate within healthcare services on what decision-makers and healthcare managers should do to improve the financial situation as costs continue to rise without an equivalent gain in productivity [3, 8, 9]. The question looming is whether productivity improvements can be reached with or without increasing available resources [6, 11]. This study gives good insights into the thoughts of senior managers at the world's leading hospitals concerning the best path ahead. Multiple hospital managers consider their patient flows to be constrained by an insufficiency of beds and staffing resources. Simultaneously they highlight a myriad of projects and solutions on how to improve the processes without increasing expenditures and how to best use already available resources. Together, these hospitals consider the path forward to be both work-method-related and resource-related, saying that much can be achieved without increasing costs. Increasing available resources to meet rising demand has been tried on multiple occasions over the last decade, many times with consequences of rising costs and rarely equal gain in productivity [9, 11, 12, 19]. One recent study also projects staffing deficiencies to rise notably over the coming decade [4], further emphasizing the need to either increase available capacity or use available resources more wisely. Hence, if increased financial support might be hard to agree upon with policymakers and politicians, our study gives multiple alternative solutions to help hospitals confront the challenges of increasing demand.

Another problem lies in a seemingly unsustainable logic prevailing in healthcare of utilizing too much available capacity. This study reveals that whenever capacity is extended, additional bed and staffing resources are quickly used, reverting capacity utilization to previous levels. Managers interviewed in this study derive this phenomenon from an infinite demand and an unsustainable logic of over-utilizing available capacity. This leads to hospital-wide overcrowding, burned-out healthcare

staff, and slow patient flow, and it ultimately reduces medical quality and patient satisfaction. The high capacity utilization creates "a drag on the system," as one manager expressed it. Even though it might seem as though resources are used optimally, seen from a resource utilization perspective, the number of patients treated by the hospital is decreasing as the throughput of patients slows down. Previous research has traditionally advocated for 85% as the optimal operating occupancy level for hospitals, stating that occupancy rates above 90% slows down the patient flow across the organization [28, 54, 55]. However, Bain et al. [56] point out that the traditionally suggested 85% occupancy level target is not an optimal, one-size-fits-all measure. Some hospitals may reach their "choke-points" at both higher and lower levels. Even so, staying at high occupancy rates, above 90%, generally has a direct negative impact on hospitals' ability to provide safe and timely services for patients [57]. However, pressing down the occupancy rates to more sustainable levels is frequently a difficult act, as the demand for healthcare services is increasing faster than the available capacity [1, 2]. Therefore, it is difficult, and many times impossible, for hospitals to say no to patients in need of care. However, as indicated here, admitting more patients might result in fewer patients being treated and, ultimately, reduced public health. Hence, adding more resources without improving the work methods and the logic of capacity utilization seems to only make hospitals repeatedly end up in the same situation. Focusing only on method improvements might be unreasonable, as there is little "free" capacity to spare for ambitious improvement projects. Consequently, this points to a strategy of building capacity to provide sufficient margins to the organization and then use that capacity to improve work methods and change the capacity utilization logic. This may improve the flow of patients, provide better and safer care for more people and enable a more sustainable work environment for healthcare professionals.

An improvement framework

It is difficult to make the patient process more efficient, and it is hard to identify the path forward in the complex environment of the modern hospital organization. To address this, we have developed a patient flow improvement framework of themes, barriers, root causes, and solutions; see Fig. 2.

The framework highlights several themes to direct readers to how and where patient flow barriers may appear across the hospital, supported by Fig. 1. The solutions are presented in Table 3 and supported by Additional file 1: Appendix A, where Åhlin et al. [40] explain the causal relationships between barriers and

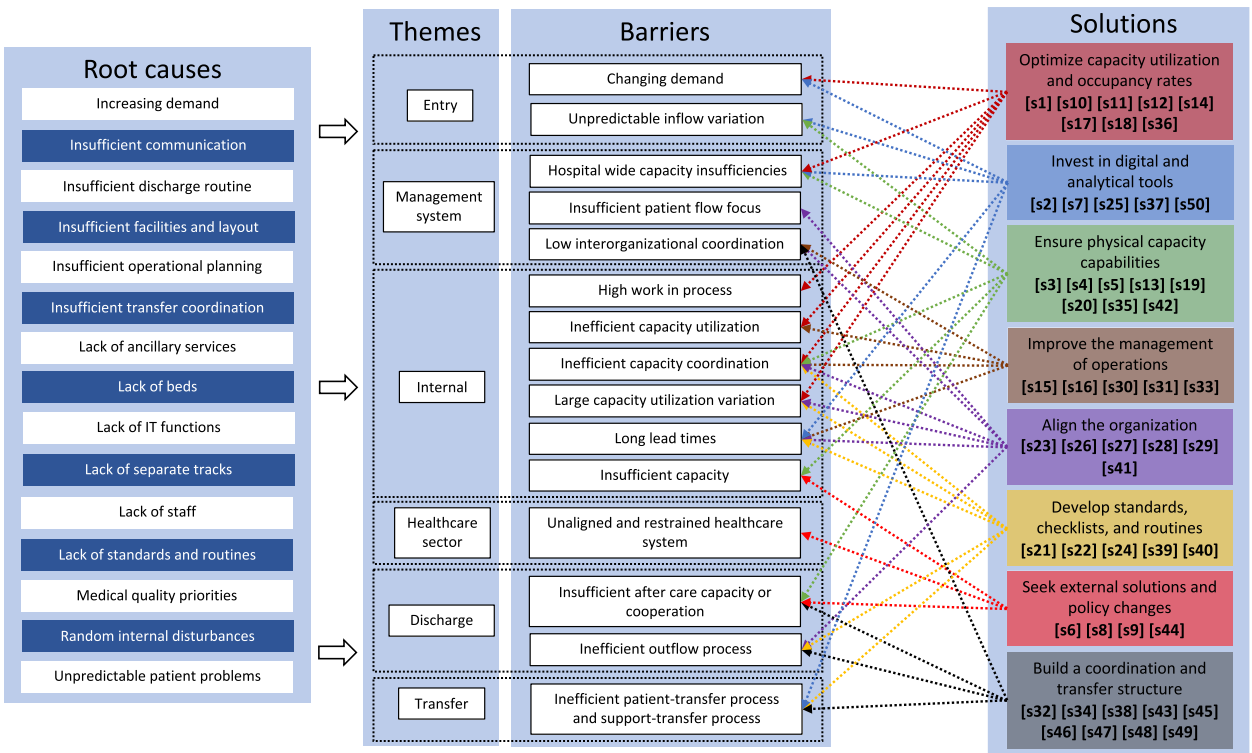

Fig. 2 The patient flow improvement framework

root causes. Hospital managers and commissioners may take several different approaches when using this framework. The framework can be used by identifying a certain root cause or barrier and then looking for appropriate solutions to implement. Another path might be to start with the desired solution and explore how and where that solution will impact the organization. A third approach could be to select a certain part of the patient flow, represented by themes, and see the associated problems and solutions. Hence, this framework serves as guidance for commissioners designing improvement strategies. Other frameworks or models to understand barriers and enablers to efficient hospital-wide patient flows can be found focusing on performance indicators [12], paradoxes of patient flow [29], Lean healthcare applications [33], and patient flow improvement strategies [22]. We believe our framework evolving from this interview study and the previous systematic literature review by Åhlin et al. [40] complement their work, and these frameworks can be used together to improve the patient flow across hospitals.

A hospital patient flow improvement plan

For hospital managers exploring the extensive list of solutions presented in this study, many of the solutions may seem too complex to implement, requiring much external cooperation and coordination. It is then closer at hand to start with solutions that only require improvement commitment within the local hospital organization. We, therefore, suggest a hospital patient flow improvement plan, highlighting what hospitals can do today without external support or collaboration; see Fig. 3 below. This improvement plan consists of three parallel improvement procedures of organizational, physical, and technological nature: *Organizational Improvement 1:*An improved collaboration between clinics and departments is necessary to spread the pressure evenly across the organization to avoid overcrowding and burned-out staff; *Organizational Improvement 2:* Staffing pools or interim personnel units are needed to ensure that staff can be moved around the hospital organization to where demand is greatest; *Organizational Improvement 3:* To better balance available bed capacity with the arrival of admitted patients, clinics must become better at setting early discharge goals and organising staff to prioritize discharge-ready

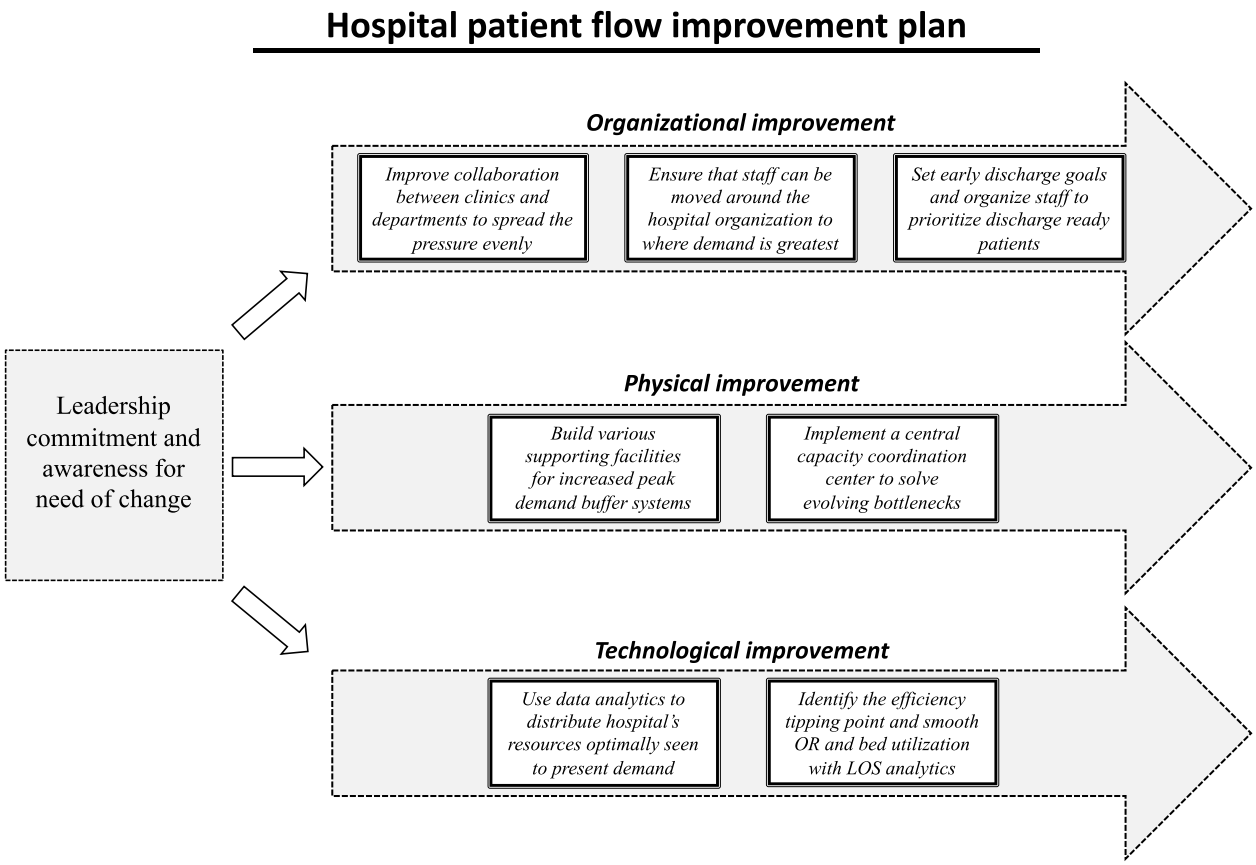

Fig. 3 The hospital patient flow improvement plan

patients; *Physical Improvement 1:* It is necessary to have an efficient central capacity coordinator, like a command centre, that oversees the capacity situation in real time and can act with a strong mandate to solve evolving bottlenecks; *Physical Improvement 2:* It is important to have various facilities that can handle sudden surges in demand, like patient hotels, discharge lounges, short-stay units, and temporary extra wards to enable buffer systems; *Technological Improvement 1:* There is a need to understand the efficiency tipping point of the hospital and to work with OR planning based on the downstream bed (ICU/ward) availability, block schedules, and surgical smoothing; *Technological Improvement 2:* It is important to assure, through data analytics and strategic capacity revisions, that the hospital's resources are distributed optimally to present demand. These perspectives demonstrate a need for hospitals to build organizations that proactively and reactively optimize capacity use around patient flows to deliver healthcare services for as many as possible and to spread the burden on healthcare professionals evenly across the organization.

When initiating an improvement plan, research on change management highlights the need for leadership commitment and an awareness of a need for change throughout the organization to enable sufficient support for the process [53, 58]. Glouberman and Mintzberg [31] and Radnor et al. [32] also explain the need for healthcare professionals to move away from the prevailing silo mindset and to take a more holistic responsibility for the purpose and outcome of the whole hospital system they belong to. We believe the processes described in this improvement plan may help increase healthcare professionals' awareness of the impact of their choices on patient flow across the hospital.

Contributions and limitations

This article gives insights on how to improve patient flows across hospital organizations. It provides concrete guidance to healthcare managers, commissioners, and decision-makers on what solutions to focus on and the barriers and root causes they are helping to overcome to provide the right care to as many patients as possible. Using a wider lens, our study provides new perspectives on the contextual and causal complexities of patient flows across hospital organizations. We encourage practitioners to approach patient flows from a hospital-wide perspective and encourage researchers to explore more aspects of the hospital-wide challenges and possibilities to improve the flow of patients across hospitals. The findings of this study call for research on how solutions for improved patient flow efficiency are best implemented and how hospitals best prioritize their hospital-wide patient flow improvement strategy. Additionally, we suggest more research on the perceptions of other professional groups across the hospital on the organizational development toward more efficient hospital-wide patient flows.

This study comes with some limitations. A research method of qualitative semi-structured interviews was used, with a substantial pilot study conducted beforehand. Even so, the interviews were conducted by a single researcher, creating a risk of subjective bias and perspectives when posing questions and guiding interviewees. Another limitation is associated with the online format, as body gestures and facial expressions are harder to capture in a non-physical setting, limiting the possibility of fully acquiring the answers and views of the participants. Furthermore, even though the thematization was conducted by three researchers in which everyone independently read through the transcribed interviews, our common background as researchers within the same field may limit our frame of reference and the width of possible interpretations. Additionally, we have large academic hospitals in this study, and their views on the most appropriate path to achieve efficient patient flows may not be useful for all types of hospitals. As such, for a more complete view, this study would need to be complemented by research on hospitals with other characteristics, like secondary care providers. Moreover, in this study, only managers were interviewed, highlighting the need to explore the hospital-wide patient flow from the perspectives of other professional groups, such as physicians or nurses working directly with patients.

Conclusion

To optimize the patient flow across the whole healthcare organization, hospitals must employ a wide array of solutions. Multiple professional, cultural, managerial, technical, and political aspects must be addressed, and a holistic strategy that covers patients' whole trajectory of care is needed. Hospitals must proactively and reactively optimize capacity use around their patient flows to ensure higher productivity and a better working environment. This study concludes that the efficiency of internal hospital-wide patient flows largely depends on collaboration and cooperation with external actors, highlighting the need to improve the flow of patients along the whole healthcare value chain. Even so, much can be done internally by the single hospital through a focus on relevant organizational, physical, and technological issues. This study also shows that even though the scapegoat for flow inefficiency at hospitals may be insufficient staffing, hospitals can do many things to improve the throughput of patients without increasing expenditures. Lastly, hospitals across both Europe and the US share, to a large degree, the same view of the path forward, indicating that

the solutions on how to improve hospital-wide patient flows apply to many hospitals and healthcare systems.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12913-022-09015-w.

Additional file 1: Appendix A. The Interview Guide.

Additional file 2: Appendix B. Open coding of interviews.

Additional file 3: Appendix C. The number of hospitals that acknowledges the need to work with a particular solution is categorized from the highest to the lowest number together with the name of the solution and associated theme.

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Authors' contributions
PÅ designed the study, conducted all interviews, and wrote the original draft. The methodology of the study was developed by PÅ and PA. All three authors (PÅ, PA, and CW) contributed to the thematization and analysis of the interviews and reviewed, edited, and approved the final manuscript. All authors of the manuscript read and agreed to its content and are accountable for all aspects of the accuracy and integrity of the manuscript. The article is original; it has not already been published in a journal and is not currently under consideration by another journal. We agree to the terms of the BioMed Central Copyright and License Agreement.

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Availability of data and materials
All datasets generated or analyzed during this study are included in the main manuscript (and its supplementary information files).

Declarations

Ethics approval and consent to participate
This study has been conducted in Sweden according to Swedish laws and regulations. Participants were interviewed in their professional roles, and no personal or sensitive information was obtained. According to the Swedish Ethical Review Act (*Lag om etikprövning av forskning som avser människor 2003:460*), this study does not need ethical clearance by a Regional Ethical Review Authority, as it does not include any primary empirical data on biological material or sensitive personal information. No ethics approval was consequently applied for before conducting this study. Informed consent was obtained from all participants, and all quotes were approved by the party concerned before publication.

Consent for publication
Consent from each participant was confirmed in conjunction with each interview, and all cited participants were contacted for approval before publication.

Competing interests
The authors declare that they have no competing interests concerning the material discussed in this manuscript. This accounts for interests of either financial (such as grants, consultancies, equities, or other employment) or non-financial nature (such as professional, personal relationships, or subjective beliefs).

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Publisher's Note

Paper III

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Focused operations to improve the patient flow in full-service healthcare organizations

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Abstract
Although full-service healthcare providers face mounting pressure to improve productivity and meet growing demand, their inherent complexity often hampers any improvements in performance. In response, we investigated how such providers can enhance their productivity by improving their operational focus. Following a systematic literature review, we developed a framework for enabling focused healthcare organisations that we subsequently applied in a single-case study of a full-service medical clinic in which we analysed care processes based on patient volumes and variety. Among our findings, mixing simple and complex care processes reduced flow efficiency, and segmenting processes into high-volume, low-variety (i.e. focused) processes and low-volume, high-variety (i.e. general) processes was key to improving productivity. Our framework offers healthcare managers an instrument for establishing strategic directions, assessing operational focus, and designing and implementing focused operations in healthcare. We advise full-service providers to adopt a dual-focus model to manage complexity, reduce inefficiencies, and avoid unsustainable care delivery practices. Although we relied on a single-case study and did not test the proposed framework, our study was the first-ever synthesis of research on the concept of the focused factory in healthcare that also evaluated its applicability in full-service hospitals.

Keywords
Swift and even flow, focused factory, throughput, productivity, efficiency

1. Introduction
At the heart of modern healthcare systems, hospitals provide an array of medical, therapeutic, diagnostic, and surgical services. However, ever-rising patient volumes, ageing populations, and increasing clinical complexity place immense strain on hospitals today (World Health Organization [WHO], 2024). One of the most visible consequences of such strain—one that is also becoming critical in many countries—is the growth in wait times for appointments, surgeries, and treatments (Organisation for Economic Co-operation and Development [OECD], 2022). Addressing those delays is challenging, for expanding the capacity of hospitals is often restricted by financial limitations and chronic staff shortages (Scheffler and Arnold, 2019). In response, policymakers and healthcare managers have increasingly focused on improving productivity and sought out ways to treat more patients using the same or even fewer resources (Johnson et al., 2020). Per the theory of swift and even flow (TSEF), the productivity of hospitals requires minimising delays as well as variation in patient flows (Schmenner and Swink, 1998). However, applying such principles in hospitals remains difficult due to the inherent complexity of care delivery. Unlike standardised manufacturing environments, hospitals have to handle a broad spectrum of diseases, conditions, and patient pathways (Glouberman and Mintzberg, 2001, Persis et al., 2020), which, in a certain sense, turns them into immensely complicated processing plants (Rechel et al., 2010).

Indeed, one approach to improving operational efficiency that has recently gained attention is conceiving healthcare facilities as focused factories. That conceptualisation, originally developed in the manufacturing sector (Skinner, 1974), suggests that concentrating on a narrow set of tasks can increase quality, lower costs, and boost efficiency (Hyer et al., 2009, KC and Terwiesch, 2011, Thirumalai and Devaraj, 2024, Vissers et al., 2010). In healthcare, the concept has largely been applied to specialised hospitals and medical clinics, who treat homogeneous patient groups (KC and Terwiesch, 2011, Pieters et al., 2010). Such providers enhance their operational focus by selectively admitting more profitable and more manageable cases, unlike full-service hospitals, which are required to offer a broad range of diagnostic, therapeutic, and emergency services across multiple medical disciplines (Ding et al., 2020, KC and Terwiesch, 2011, Thirumalai and Devaraj, 2024). As a consequence, full-service hospitals are often left to care for more complex and severely ill patients, which makes efficient care delivery increasingly difficult (Thirumalai and Devaraj, 2024). Among other constraints, hospitals operate under the influence of political reforms that increasingly tie funding to performance targets, including wait times for first-visit appointments and surgeries, which has sharpened their focus on high-volume patient groups and early stages of care (Rönnerstrand and Oskarson, 2020). Worldwide, nationally imposed standardised care pathways (e.g. for cancer) additionally force clinics to prioritise cancer patients while potentially neglecting others (Olsson, 2020). Beyond that, the profession-driven healthcare environment, in which the specialisation of physicians often clashes with administrative and political priorities, complicates the design of healthcare services (Glouberman and Mintzberg, 2001). For that reason, many healthcare professionals have chosen to leave full-

service providers for specialised facilities that offer better pay and less stressful conditions, in a trend that has only exacerbated the preexisting capacity crisis (Dabhilkar and Svarts, 2019, Ding, 2024, Strumann et al., 2022).

Despite the potential of the focused factory approach, research has been limited on how the approach can be adapted to full-service hospital settings that need to accommodate patient diversity and complex care processes. To date, most studies have investigated specialised providers, thereby leaving a gap in current understandings of how operational focus might be achieved in full-service hospitals. In response, the objective of our study was to explore how operational focus can be enhanced in full-service healthcare organisations as a means to improve productivity despite patient complexity. More specifically, we aimed to (1) explore how the concept of the focused factory has been applied in healthcare to achieve operational focus, (2) examine the current state of operational focus in a full-service provider, and (3) investigate how the concept can be adapted to fit complex hospital environments. To achieve those aims, we conducted a systematic literature review and, based on our findings, developed a framework that applies the concept of the focused factory in healthcare. After that, we conducted a single-case study on a full-service medical clinic to analyse its patient processes and assess how our framework could guide improvements in the clinic's operational focus.

2. Theoretical framework

2.1 Theory of swift and even flow (TSEF) and focused operations

The TSEF, as defined by Schmenner and Swink (1998), unifies what are commonly referred to as the laws of operations management (Onofrei et al., 2020, Seuring, 2009). According to Schmenner and Swink (1998), traditional microeconomic theory is useful in understanding how labour and capital inputs translate into productivity but contributes little to multiple aspects of factory floor operations—for example, variability in quality and demand, workforce organisation, and process bottlenecks. The TSEF does not disagree with microeconomic theory but does emphasise the fundamentals behind what makes processes swift and even (i.e. productive) as *the* prerequisite of all economic success (Schmenner, 2015). The theory advocates not only creating focused cells of production to increase productivity but also grouping similar products together to reduce variability and complexity (Devaraj et al., 2013, Onofrei et al., 2020, Wikner et al., 2017). The ultimate origin of focus in operations is the division of labour, and in his book *The Wealth of Nations*, Adam Smith (1776) presents the benefits of specialisation that allow firms to efficiently turn resources into products. In follow-up, Wickham Skinner (1974) argues in his pioneering article *The Focused Factory* that firms need to prioritise between cost, quality, speed, and flexibility and that neglecting to do so—that is, sacrificing performance in some objectives in order to excel in others—will ultimately make them second-best in them all. The core idea of focus is thus to reduce complexity and excel by concentrating on fewer tasks (Pieters et al., 2010). As a case in point, cellular manufacturing, a within-plant application, reveals that the concept of the focused factory is also applicable to smaller units and designed to exploit similarities in how information is processed, how products are made, and how customers are serviced and to closely locate people and equipment needed to produce similar types of products (Hyer et al., 2009, Wikner et al., 2017).

2.2 Pathways, service lines, and specialised facilities

Focus projects in healthcare often take the form of clinical pathways (CPWs), also called "care pathways" and "clinical protocols". CPWs are structured, multidisciplinary care plans that outline essential steps in treating specific patient groups with particular clinical conditions over a defined period (Lawal et al., 2016). CPWs aim to improve medical quality by standardising best practices, reducing variation, cutting costs, and optimising outcomes for specific patient groups (Rotter et al., 2010). The development of CPWs has taken inspiration from the critical path method used in manufacturing and in implementing CPWs for specific diseases, which requires clearly identifying tasks within care processes (Luo et al., 2021). We argue that CPWs represent a bottom-up approach to achieving operational focus, one tailored for specific patient groups and implemented by professionals to enhance the quality of care. That view is supported by the work of Bjurling-Sjoberg et al. (2018), who have explained that although clinical guidelines are typically developed in top-down fashion, care pathways often emerge from the bottom-up as a means to fit local service configurations precisely. Evidence also suggests that CPWs improve medical quality, reduce costs, and shorten the length of stay for targeted patient groups (Luo et al., 2021, Rotter et al., 2010). However, recent studies have identified crowding-out effects, in which improvements for one patient group create disadvantages for another, and shown that patient groups with clear CPWs experience shorter wait times at the expense of others (Olsson, 2020).

Focus projects can also be driven by organisational and economic factors, particularly through the development of hospital service lines that group patients with similar needs and co-locate the resources required to treat them. Service lines are typically developed around specific services (e.g. cardiac or orthopaedic care), market segments (e.g. adults or children), or a combination thereof (Hyer et al., 2009). Similar to managing product portfolios in manufacturing, hospitals may assess their services by focusing on ones essential to long-term success while de-

prioritising less valuable ones (Ding, 2024). Regarding the outcomes of service lines, research has shown a mixed picture, with some studies revealing little to no improvement in performance (Byrne et al., 2004, Hyer et al., 2009), while others suggest increased efficiency through specialisation (Ding, 2014, McDermott and Stock, 2011). Added to that, for-profit hospitals are more likely to develop service lines based on profitability and, as a consequence, often avoid complex patient groups.

A higher-level approach to achieving focus in healthcare involves designing specialised facilities, including specialty hospitals (e.g. cardiac hospitals) and ambulatory surgery centres, which aligns with the concept of the focused factory (Dabhilkar and Svarts, 2019, De Regge et al., 2017). In recent decades, those specialised facilities have emerged alongside traditional full-service hospitals as alternative care settings and concentrate on specific operations that are detached, independent, planned, repetitive, and predictable and involve patients with low comorbidity (Dabhilkar and Svarts, 2019). The goal, as in developing service lines, is to reduce complexity by focusing on a limited set of operations (Karvonen et al., 2022). Concentrating resources in narrow areas allows employees to develop tacit knowledge and coordinate care processes more efficiently (Ding, 2024, Zepeda et al., 2021, De Regge et al., 2019). We argue that developing service lines and specialised facilities represents a top-down approach to operational focus that is consistent with the concept of the focused factory. Studies by KC and Terwiesch (2011) and Kuntz et al. (2019) have additionally suggested that specialised facilities generally outperform full-service hospitals in terms of quality, throughput, and cost. The underlying premise is that concentrating cases in one or a few service area(s) enables staff to manage clinical conditions more efficiently (Zepeda et al., 2021). Indeed, other studies have highlighted that specialised facilities improve medical quality, enhance patient satisfaction, and offer lower-cost services (Hyer et al., 2009).

2.3 Volume and variety

Christensen et al. (2009) have identified the coexistence of two fundamentally misaligned operational models as theroot cause of managerial complexity in healthcare. One is the value-adding process for standardised, routine treatments for patients with well-organised conditions, while the other is the solution shop for complex and hard-to-diagnose patients. In turn, Kuntz et al. (2019) have argued that the two models are challenging to combine and, for that reason, that it is important to separate complex patient groups and care processes from the simpler, standardised ones in order to improve operational efficiency. The idea of separating the complex from the simple—a pillar of the focused factory (Skinner, 1974)—has been developed by Hayes and Wheelwright (1979) to describe the need to match the focus of products with the focus of processes for a full and complete operational focus. The product–process matrix, illustrated in Figure 1, is thus a classical framework in operations management that emphasises the need to coordinate market strategy and production strategy in order to become competitive (Ahmad and Schroeder, 2002, Hayes and Wheelwright, 1979).

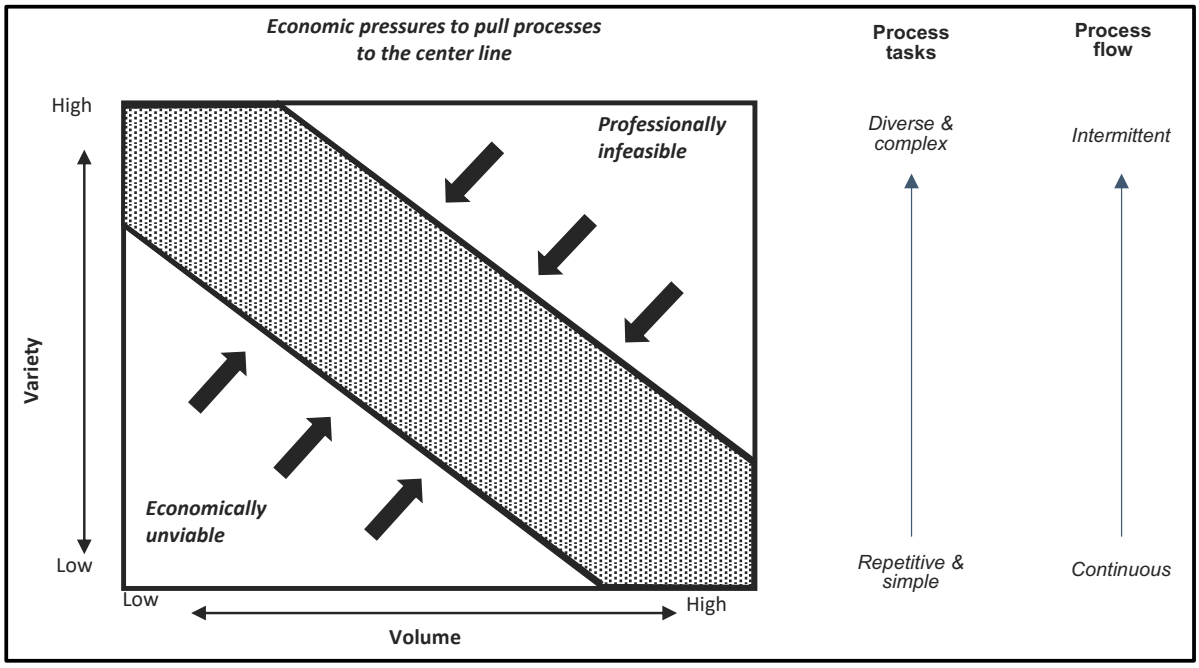


Figure 1: The product–process matrix adapted to a healthcare context

The product–process matrix showcases how a process can be designed in numerous ways but that only one or a few designs guarantee the best fit between operational resources and external requirements. The optimal design

is defined by the process's relationship to the volume and variety of its products and/or services and has to follow those dimensions in order to become economically viable and technically feasible (Holweg et al., 2018). When the variety of products or services within a process increases, the tasks therein subsequently change from repetitive and simple to diverse and complex, while the flow of the process changes from continuous to intermittent (Holweg et al., 2018). We argue that separating patients with well-organised conditions from complex, hard-to-diagnose patients, as suggested by Christensen et al. (2009) and Kuntz et al. (2019), can be supported by using the process–product matrix. At the same time, to adapt the matrix to a healthcare context, we have chosen to change the dimension "technically infeasible" (i.e. machines or technological setups cannot switch quickly enough between various operations) to "professionally infeasible" (i.e. healthcare professionals' skill set is too narrow to efficiently care for such a large, highly diverse population of patients).

2.4 A model for operational focus

In line with Christensen et al. (2009) and Kuntz et al. (2019), we propose a model that visualises the various strategic approaches to enable operational focus (see Figure 2). The model separates focused facilities, service lines, and pathways (i.e., repetitive, simple process with a high volume of low-variety patients) from general facilities, service lines, and pathways (i.e., diverse, complex processes with a low volume of high-variety patients). A full-service provider can choose either approach, or a combination of them, but has to clearly define what is considered to be focused and what is considered to be general.

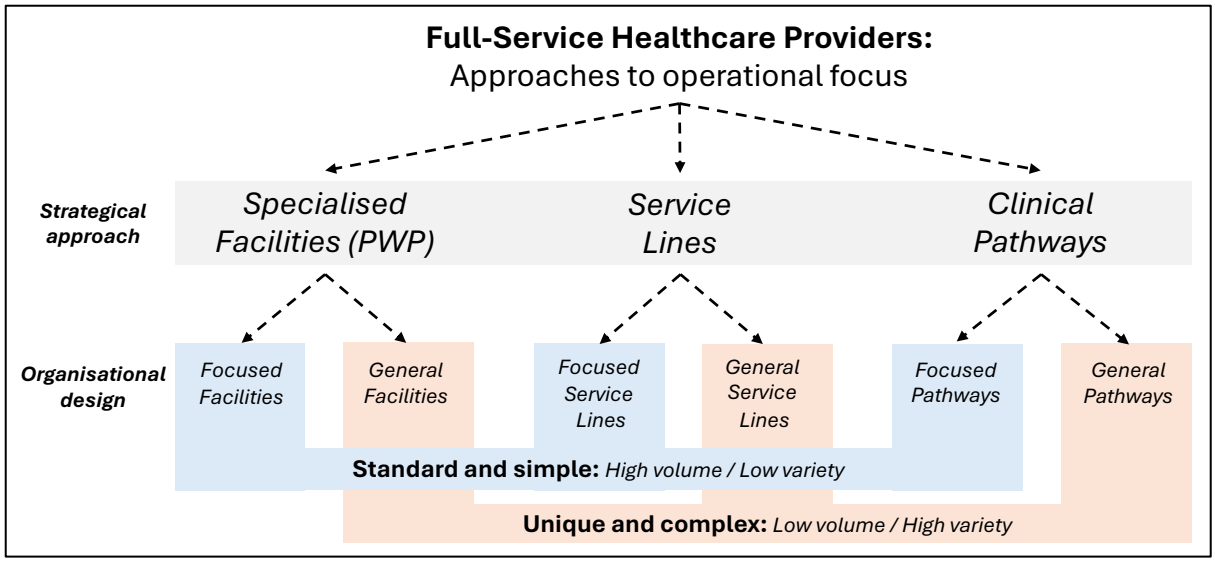


Figure 2: Approaches for focus for full-service healthcare providers

3. Research design and methodology

Due to the limited empirical research on applying operational focus in full-service healthcare organisations, we conducted an exploratory mixed-methods, single-case study. Such an approach is suitable when the purpose of research is to answer "how" questions, unravel complex elements (Eisenhardt and Graebner, 2007, Yin and Campbell, 2018), and develop theory (Edmondson and McManus, 2007, Gioia et al., 2013). In particular, case research is suitable when little is known about a phenomenon, for it allows a single case to provide an in-depth understanding of a specific problem and context (Flyvbjerg, 2022). Yin (2018) has identified three types of case studies—exploratory, explanatory, and descriptive—in which the exploratory stage, prior to developing theory, aims to "uncover areas for research and theory development". Mixed-methods approaches, which necessarily combine quantitative and qualitative methods, are valuable for comprehensively addressing research questions (Clark and Ivankova, 2016). Whereas a qualitative approach offers deeper insights into real-world problems, quantitative research can help to reveal broader trends (Guetterman et al., 2015). Although statistical generalisations cannot be drawn from single cases, the single-case study approach is appropriate for exploring an underexamined phenomenon instead of seeking generalisation (Ketokivi and Jokinen, 2006). Considering all of the above, our study proceeded in three sequential steps. First, we conducted a systematic literature review to investigate the application and implementation of the concept of the focused factory in healthcare. The review served as a preface to the case study at a medical clinic, which examined how the clinic organises patient processes in consideration of patient volumes and variety. Third and last, we integrated the insights from the literature review with the case study's findings to explore how existing knowledge on achieving operational focus at specialised facilities can enhance the operational focus of full-service healthcare providers.

3.1 Systematic literature review

We conducted our systematic literature review following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses—that is, the PRISMA statement (Moher et al., 2009). The search for literature was performed in the PubMed, Scopus, and Web of Science databases for relevant English-language articles published through 31 December 2023. We began by identifying suitable Medical Subject Headings (MeSH) and related free-text keywords for an initial search of PubMed. Ultimately, we selected a broad combination of keywords, including terms related to "hospital" or "healthcare" and "focused factory" or "focused factories". The search string was next adapted for Scopus and Web of Science. Table 1 lists the full searches that we used. In the first round of screening, we read titles, keywords, and abstracts to make an initial selection. Generous early inclusion criteria were followed, including being peer-reviewed and relating to our research's aims. In the second round of screening, all remaining articles were examined in detail according to predefined inclusion and exclusion criteria, also shown in Table 1. For inclusion, the articles had to meet four criteria: contain an abstract, be written in English, explore the application and implementation of the concept of the focused factory in healthcare, and be published on or before 31 December 2023. Articles were excluded if they addressed primary care or care within a rehabilitation setting; examined healthcare processes not related to the patient process at hospitals (e.g. healthcare providers with only diagnostic or laboratory processes); described theories, methods, or models without empirical data; were editorials or policy statements without immediate empirical support; or were literature reviews. The inclusion–exclusion process was designed to select empirical studies that explicitly examined the application and implementation of the concept of the focused factory in healthcare to enhance operational focus. In the endeavour, our experience working with patient flows at hospitals (i.e. PÅ and SH) and studying healthcare productivity (i.e. PA) reduced the risk of errors in the selection process. The two rounds of screening articles yielded a highly relevant set of studies for the review and synthesis. Any disagreements regarding which articles to include or exclude throughout the selection process were resolved in discussions with all authors.

Table 1: Keyword search strategy and inclusion and exclusion criteria

Database	Keyword Search
PubMed	("Health Care Sector"[Mesh] OR "Healthcare"[tiab] OR "Health"[tiab] OR "Hospitals"[Mesh] OR "Hospital*"[tiab] OR "Health Facilities"[Mesh] OR "Health Facilit*"[tiab] OR "Medical Clinic*"[tiab] OR "Hospital Industr*"[tiab] OR "Health System*"[tiab] OR "Patient*"[tiab] OR "Ambulatory"[tiab] OR "Inpatient"[tiab] OR "Outpatient"[tiab] OR "Surger*"[tiab] OR "Ward*"[tiab] OR "Emergen*"[tiab] OR "Acute Care"[tiab] OR "ED"[tiab]) AND ("Focused Factory"[tiab] OR "Focused Factories"[tiab])
Scopus	((TITLE-ABS-KEY (hospital*) OR TITLE-ABS-KEY (healthcare) OR TITLE-ABS-KEY (health) OR TITLE-ABS-KEY (patient*) OR TITLE-ABS-KEY (inpatient) OR TITLE-ABS-KEY (outpatient) OR TITLE-ABS-KEY (ambulatory) OR TITLE-ABS-KEY ("Medical Clinic*") OR TITLE-ABS-KEY ("Health System*") OR TITLE-ABS-KEY ("Hospital Industr*") OR TITLE-ABS-KEY (surgery*) OR TITLE-ABS-KEY (ward*) OR TITLE-ABS-KEY ("Health Facilit*") OR TITLE-ABS-KEY (ed) OR TITLE-ABS-KEY (emergen*) OR TITLE-ABS-KEY (acute AND care)) AND (TITLE-ABS-KEY ("Focused Factory") OR TITLE-ABS-KEY ("Focused Factories")))
Web Of Science	(TS=(hospital*) OR TS=(healthcare) OR TS=(Patient*) OR TS=(Outpatient) OR TS=(Ambulatory Clinic*) OR TS=(Inpatient) OR TS=(Medical clinic*) OR TS=(health) OR TS=(Health System*) OR TS=(Hospital Industry) OR TS=(Surger*) OR TS=(Ward*) OR TS=(Health Facilit*) OR TS=(ED) OR TS=(Emergen*) OR TS=(Acute Care)) AND (TS=("Focused Factory") OR TS=("Focused Factories"))
Category	**Inclusion and Exclusion Criteria**
Inclusion Criteria	**The article must:** Contain an abstract; Be written in English; Exploring the application and implementation of the focused factory concept in healthcare; Have been published before 31st December 2023
Exclusion Criteria	**The article has a focus on:** Primary care or care within a rehabilitation setting; Healthcare processes not relating to the hospital patient process; Description of theories, methods or models without empirical data; Editorials or policy statements without immediate empirical support; Literature reviews

A predefined extraction checklist was used to capture key characteristics of articles, including title, author(s), year of publication, country of study, and intervention type (see Appendix A). By following a thematic synthesis methodology (Braun and Clarke, 2006), we ensured a consistent analysis of the content and identified key themes. In thematic syntheses, articles are coded line-by-line into "free codes," which are subsequently grouped into descriptive themes based on their recurrence and further developed into analytical themes to describe specific phenomena (Dixon-Woods et al., 2006). Accordingly, one author (i.e. PÅ) coded each article and its content, while the other authors (i.e. PA and SH) assessed and evaluated the coding as it proceeded. The aim was to capture all perspectives of the application and implementation of the concept of the focused factory, and eventually, a list of important aspects was identified for each article. In the second round of coding, similar codes were analysed, discussed, and grouped based on similarity until only unique groups remained, which produced a final list of unique aspects. For a full overview of all identified codes from the process, see Table 2.

3.2 Case study

3.2.1 Case selection

Following the principles of theoretical sampling (Eisenhardt and Graebner, 2007), we targeted a representative full-service medical clinic within a general hospital that offers inpatient and outpatient care for patients with acute, non-acute, and chronic conditions, including surgeries, examinations, treatments, and counselling appointments. Selecting a clinic based on those criteria allowed us to examine the operational complexity typical of full-service providers. After discussions with the board of a major hospital in northern Europe, we identified their ear, nose, and throat (ENT) clinic as an ideal setting for our study. The clinic met our criteria of providing care to a broad range of patients and thus offered a robust environment for exploring process design in complex settings. Beyond that, the clinic has recently faced common challenges, including rising costs, an inability to reach target times for appointments and surgeries, and a deteriorating work environment.

3.2.2 Case context

The case clinic is part of a large, publicly funded university hospital spread across three sites in a large Swedish municipality. The hospital functions as both an emergency hospital and a community hospital for the city, as well as a tertiary care provider for a broad surrounding region. It also has a national mandate to treat specific diseases, which attracts patients from across the country and around the world. The clinic operates at two of the hospital's sites, with seven outpatient wards and one inpatient ward. Annually, the clinic handles approximately 35,000 outpatient visits, 3000 surgeries, 1800 inpatient admissions, and 8000 emergency visits, which together cover approximately 1800 unique diagnostic codes. It collaborates extensively with other clinics on surgeries and treatments requiring coordination as well as with independent ENT specialists and centres. The clinic's management structure includes a clinic manager, a business developer, a data administrator, two chief medical officers, six medical team leaders, and a nurse unit manager for each outpatient ward and inpatient ward. Physicians are organised into medical teams, whereas nurses and other professionals are organised by physical unit. The clinic's activities are centred around six care teams: Oto, Rhino (i.e. nose), Phoniatrics (i.e. voice and speech), Audiology (i.e. hearing and balance), Laryngology (i.e. throat), and Tumour (i.e. malignant and benign cancers). Patients are assigned to teams based on their conditions or are jointly managed if their issues overlap.

3.2.3 Case study: Step 1

The description in this subsection serves two purposes: to provide a clear procedure that other organisations can follow when describing or exploring the design of healthcare processes and to demonstrate how our study was conducted. The case study was performed in two steps. Step 1 involved mapping key activities of the clinic's processes and visually representing them from one (or multiple) starting points to endpoints, which captured all activities that directly impact the patient's journey. The transfer of a patient between two processes was also considered to be a starting point or endpoint. Mapping was performed in three stages. In the first stage, three researchers collaborated with two clinicians, a chief medical officer, and a medical team leader to define and visualise each of the clinic's processes. Those objectives were achieved in four 2-hour sessions involving open discussions about the definition, inclusion, and exclusion of elements in each process. Unique processes were defined as serving a distinct set of patient groups using specific resources and/or staffing competencies, with activities not performed within other processes. Altogether, 25 unique processes were identified: 19 outpatient care processes (i.e. divided among teams), an emergency care process, and four surgical processes shared between teams. In the second stage, team leaders reviewed all mapped processes that they were involved in. Although no new processes were added, removed, or renamed, many elements within existing processes were adjusted based on the team leaders' feedback. Last, in the third stage, a physical workshop was conducted with the full management team to discuss care maps and identify errors and overlaps. The workshop provided in-depth insights into team leaders' perspectives and led to some changes, not to mention valuable discussions among professionals regarding the visualised care processes. Data collection for Step 1 took place between November 2021 and March 2022.

3.2.4 Case study: Step 2

Step 2 of the case study involved analysing the variety and volume of patients across the clinic's 25 processes, with a focus on understanding each process's complexity and operational aspects. To gather data, we extracted statistics for all patients treated at the ENT clinic in 2019, which ensured representative data unaffected by the COVID-19 pandemic. The data collected included time and date of visit, diagnostic code, surgical code (if applicable), type of treatment or intervention, care profession, and physical location. Using those data, we matched patient visits with the identified care processes. For the few cases in which it was challenging to determine the care team responsible, a chief medical officer assisted in the sorting, which enabled us to create a comprehensive list of diagnoses associated with each care process. The list was subsequently reviewed by team leaders to correct any errors and misclassifications, which resulted in a finalised list of diagnoses for patients treated at the clinic, categorised according to the 25 care processes. Last, using the process maps and patient data, we analysed each care process in terms of the design and number of patients and diagnoses. Data collection for Step 2 took place between October 2022 and January 2023.

4. Results

4.1 Systematic literature review

Our review yielded a total of 89 articles. After duplicates were removed, 45 articles were selected for a detailed review, and only 11 articles were included in the thematic synthesis. Figure 3 depicts the full process of article selection.

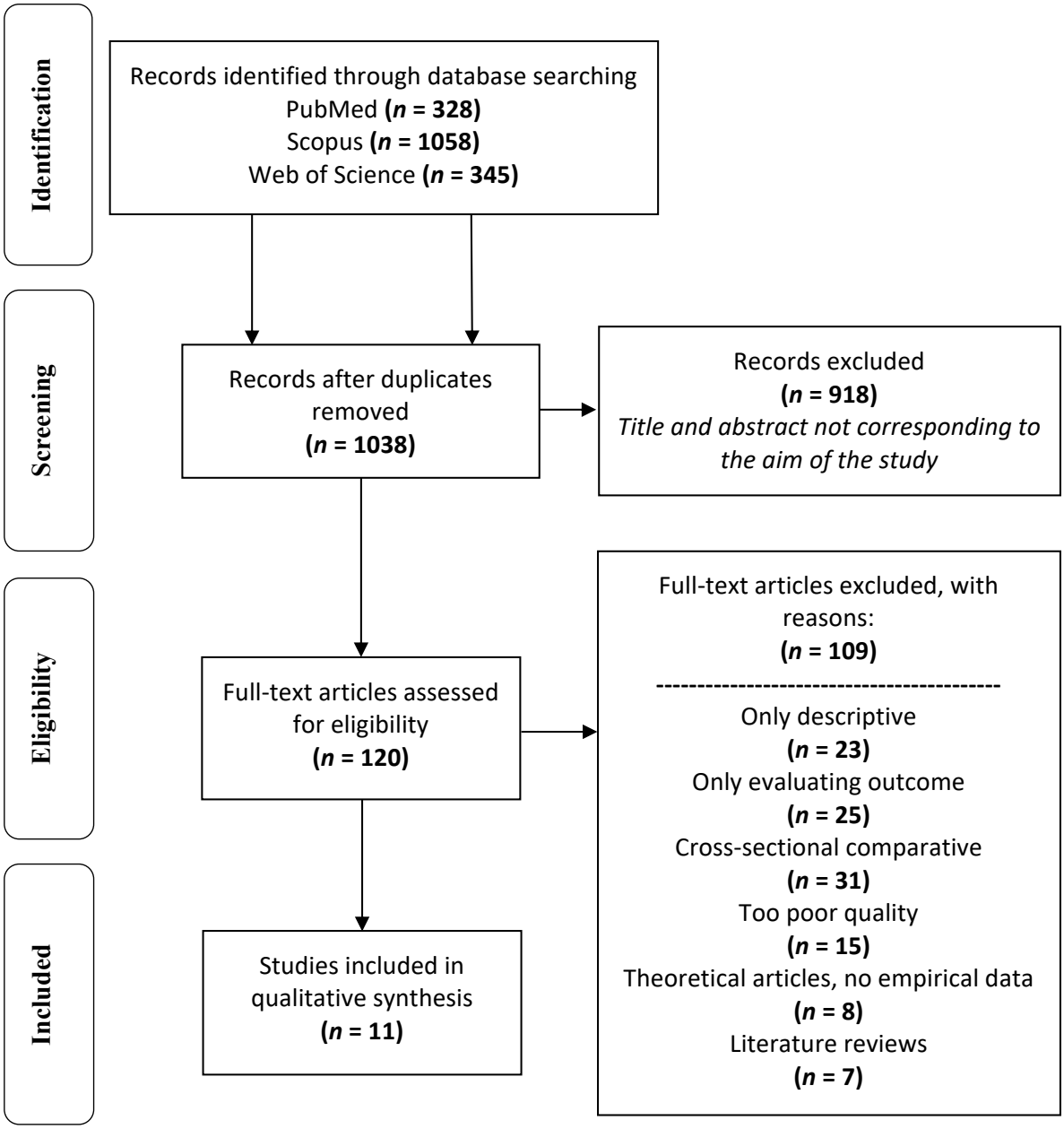


Figure 3: The literature selection process

The review captured articles that address the application and implementation of the concept of the focused factory in healthcare. We synthesised the findings into a framework for focused healthcare operations (FHOs), shown in Figure 4. The synthesis is presented in Table 2, where numbers 1–3 and letters A–J provide connections between every theme from each included article and the framework.

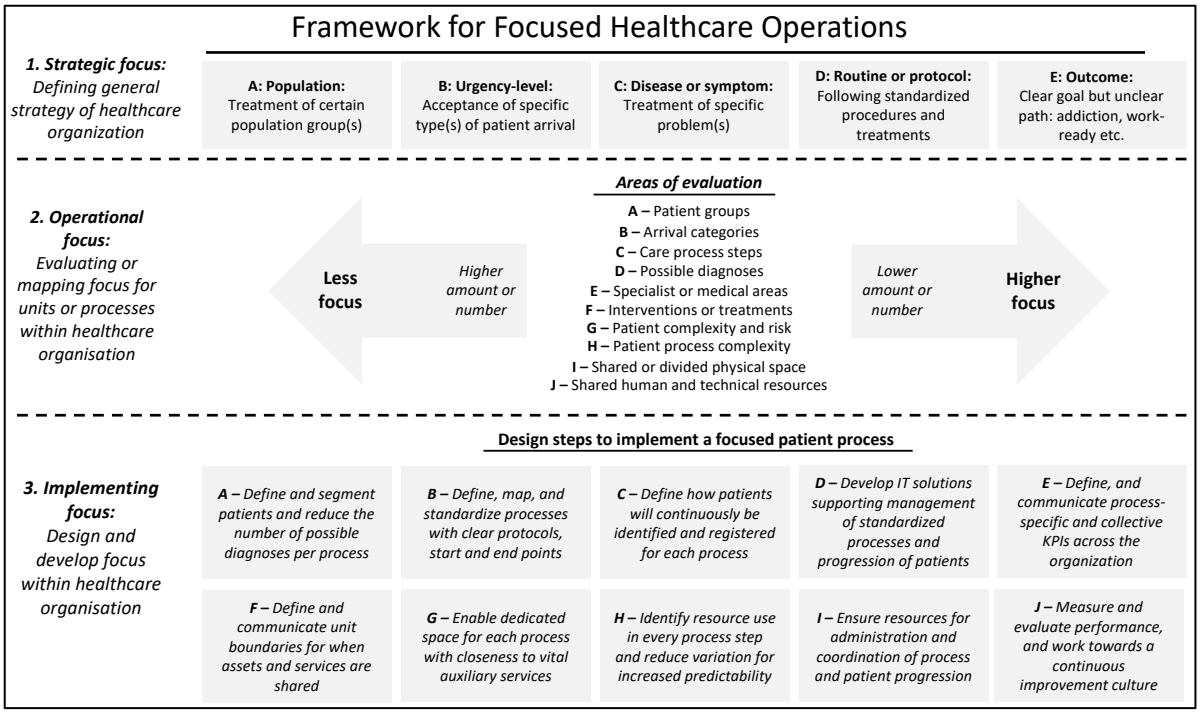


Figure 4: The focused healthcare operations (FHO) framework

From the synthesis of the articles reviewed, we found that focus at hospitals and medical clinics is enabled through three steps. Based on the findings by Bredenhof et al. (2010), Dabhilkar and Svarts (2019), and Peltokorpi et al. (2016), we propose that the first step to achieving focus in a healthcare organisation is developing a high-level focus strategy for the entire organisation. The strategy can target a specific patient population (**1A**) or a specific care procedure or routine (**1B**). The treatment of specific diseases or symptoms for patients with certain diagnostic codes (**1C**) is another option. The urgency at the patient's arrival (**1D**) and the targeted outcome at the end of the care path (**1E**) are still other examples. However, those categories are rarely mutually exclusive. In practice, hospitals often combine those focal areas—for example, by focusing on urgent orthopaedic procedures (**1B** + **1D**) for older adults (**1A**). Therefore, organisations have to evaluate which combinations best align with their goals and constraints, including demand, available expertise, and resource limitations. Because a multidimensional focus can enhance efficiency but may increase complexity, both have to be balanced through careful operational planning.

Table 2: Synthesis of literature on applications of the focused factory in healthcare

Articles	Journals	1. Strategic focus	2. Operational focus	3. Implementing focus
Bredenhoff et al., 2010	*BMC: health services research*	● Patient group focus - 1A ● Care process focus - 1D ● Patient group & care process focus 1A/1D	● Number of patient groups - 2D ● Number of medical specialites - 2E ● Level of patient complexity - 2G ● Level of process complexity - 2H	N/A
Cook et al., 2014a	*American Journal of Medical Quality*	N/A	● Level of patient complexity - 2G ● Level of process standardization - 2H ● Level of process complexity - 2H	● Create clear routines within care pathways - 3B ● Decide how patients will be registered - 3C ● Create tool to identify patients whose care can be standardized - 3D ● Communicate patients pathway status to caregivers - 3E ● Measure, report and follow-up on results - 3J
Cook et al., 2014b	*Health affairs*	N/A	● Number of possible patient types - 2D ● Range of interventions - 2F ● Level of process complexity - 2H	● Idenfiy and segment patients - 3A ● Locate similar treatments near each other for a "one-stop-shop" - 3A ● Build clear processes with protocols for each part of process - 3B ● Connect IT-systems supporting patient process - 3D ● Identify resource use in each process step - 3H ● Give mandate to people who can advance patient process - 3I
Dahbilkar and Svarts, 2019	*Operations Management Research*	● Patient group focus - 1A ● Diagnosis focus - 1C ● Knowledge focus - 1D ● Procedure focus - 1D ● Patient complexity focus - 1C/1D	● Number of possible diagnoses - 2C ● Number of patient groups - 2D ● Number of specialists/areas involved - 2E ● Number of treatments - 2F ● Complexity and risk associated with patient group - 2G	N/A
De Regge et al., 2016	*Acta Clinica Belgica*	N/A	● Degree of patient variety - 2C/2D ● Degree of medical specialization - 2E ● Level of standardization - 2H ● Closeness in time and space of Interventions - 2I	N/A
Huckman 2009	*Harvard Business Review*	N/A	N/A	● Set clear goals supported by whole organisation - 3E ● Highlight need for individual and collective goals - 3E ● Have individual KPIs in line with goals and incentives - 3E ● Make everyone understand how assets and services are shared - 3F ● Set clear unit boundaries to define when assets and services are shared - 3F ● View each unit/group as perpetual works in progress - 3J
Hyer et al. 2009	*Journal of Operations Management*	N/A	● Number of possible symptoms or diagnoses - 2C ● Level of similarity among patients - 2D ● Level of dedicated physical space - 2I ● Level of dedicated resources - 2J	● Have a clearly described patient population - 3A ● Build a clear process map from start to end - 3B ● Use standards and protocols for less variation and better communication - 3B ● "Cross train" staff to ensure flexibility across unit - 3F ● Have vital auxilliary services in close association - 3G ● Have dedicated space for closeness and efficiency - 3G ● Build a business mindset among managers - 3I ● Have sufficient resources for administration of process - 3I ● Ensure sufficient resources for downstream coordination - 3I ● Build a continuous improvement and "can do" culture - 3J
Peltokorpi et al., 2011	*Service Research & Innovation Institute (SRII)*	N/A	● Number of possible diagnoses - 2C ● Number of patient groups - 2D ● Level of variation within process - 2C/2D/DG ● Level of standardization in process or procedure - 2H	● Reduce diagnoses, symptoms and patient groups - 3A ● Reduce number of arrival categories - 3B ● Define type of process or procedure to enable standardization - 3B ● Reduce capacity use and outcome variation for increased predictability - 3H
Peltokorpi et al., 2015	*International Journal of Health Care Qualtiy Assurance*	● Population focus - 1A ● Urgency-level focus - 1B ● Disease or symptom focus - 1C ● Routine or protocol focus - 1D ● Outcome focus - 1E	● Number of patient arrival categories - 2A ● Number of possible diagnoses - 2C ● Number of patient populations - 2D ● Number of procedures or treatments - 2F	N/A
Pieters et al., 2010	*Int. Journal of Operations & Production Management*	N/A	N/A	● Split patients into complex and simple - 3A ● Build integrated care process with clear location and single entry point - 3B ● Evaluate fit between organisational and operational performance - 3E
Vissers et al., 2006	*Int. Series in Operations Research & Management Science*	N/A	● Predictability of care process - 2A/2C/2D/2G ● Number of process steps - 2B ● Amount of chronic patients without end point - 2G ● Level of process complexity - 2H ● Level of shared or dedicated resources - 2I/2J	N/A

The second step of the framework encompasses the development of operational focus by evaluating and mapping the level of focus of units and processes within healthcare organisations. Multiple studies have produced checklists to analyse the focus of units, processes, and/or pathways (Cook et al., 2014a, Cook et al., 2014b, Dabhilkar and Svarts, 2019, De Regge et al., 2017, Hyer et al., 2009, Peltokorpi et al., 2011, Peltokorpi et al., 2016, Vissers, 2006, Bredenhoff et al., 2010). On those checklists, the most emphasised category is the complexity of the patient process **(2H)**, in which focus may increase by reducing the variation of the process or by increasing its standardisation or predictability. Multiple studies have highlighted the number of patient groups in the process **(2A)** and clarified that increased focus comes with a reduction in patient groups or from gathering only one or similar type(s) of patient group(s). Several studies have also examined the number of possible diagnoses **(2D)** and described that greater focus comes from reducing the number within a care process or from only allowing patients with very similar diagnoses. Three studies have shown that reducing the number of interventions or treatments **(2E)** can boost operational focus, as can reducing specialist areas or medical areas **(2F**). The level of patient complexity and risk has also been highlighted **(2G)** as an important factor, along with the level of shared or divided physical space **(2I)**. Last, the level of shared human and technical resources **(2J)**, the number of ways to arrive at the process **(2B)**, and the number of steps in the process **(2C)** are additionally emphasised as important aspects when evaluating and mapping operational focus. They are also interdependent. For instance, reducing the number

of diagnoses (**2D**) may reduce patient complexity (**2G**) and allow fewer interventions (**2E**). Similarly, operational focus is constrained by strategic decisions; for instance, a broad strategic focus on complex chronic diseases (**1C + 1G**) may require more flexible operational processes. Therefore, organisations have to consider how operational and strategic dimensions reinforce or challenge each other. Overall, despite some differences between studies, they largely corroborate each other's findings.

The third and final step of the framework encompasses the design and implementation of focus and ways to successfully implement focus in healthcare organisations. Multiple researchers who have studied the topic have come to similar but sometimes diverging conclusions on how to proceed with designing and implementing focus (Cook et al., 2014a, Cook et al., 2014b, Huckman, 2009, Hyer et al., 2009, Peltokorpi et al., 2011, Pieters et al., 2010). Some have developed long, elaborate lists of activities to follow, whereas others have only presented a few important categories when implementing focus in their care pathways. Moreover, those articles do not suggest any sequence to the activities but present them as equal from a temporal perspective. In our framework, to the best of our ability and drawing from experience with improvement-oriented projects, we have structured them in chronological order from the design phase to the management phase. As suggested, it is important to define and segment patients and reduce the number of possible diagnoses per process **(3A)**, as well as to define, map, and standardise processes with clear protocols and clear starting points and endpoints **(3B).** There is also a need to define ways to continuously identify and register patients for each process **(3C)** and to develop IT solutions that support the management of standardised processes and the progression of patients **(3D)**. Added to that, developing and communicating suitable goals and process-specific and collective key performance indicators across the organisation is important **(3E)**. There is also a need to define and communicate unit boundaries when assets and services are shared **(3F)** and to enable dedicated space for each process with proximity to vital auxiliary services **(3G)**. Moreover, it is important to identify resources used in every step of the process and to reduce variety for increased predictability **(3H)**, and resources need to be secured for administering and coordinating processes and patients' progression (**3I**). Last, performance has to be continuously measured and evaluated, and, in turn, enabling a culture of continued improvement is pivotal (**3J**). It is also critical to recognise that successful implementation does not merely involve static design but ongoing adaptation. Thus, performance has to be continuously measured, evaluated, and improved, which aligns with lean healthcare principles and the findings of Hyer et al. (2009) and Cook et al. (2014b), who have shown that feedback loops, visual management, and daily team meetings contribute to sustained improvement.

4.2 Case study

4.2.1 Structure, volume, and variety

The results of the case study are presented in two steps. First, we outline the findings from our analysis of the case study, followed by the application of the FHO framework to the case. From analysing the ENT clinic, we identified and visualised, with the use of process mapping, 25 unique patient processes (see Appendix B). For each process, patient visit statistics were extracted (see Appendix C). Some processes were observed to consist of a few steps, be linear in structure, and involve minimal interaction with internal or external actors, with few backwards loops (see Figure 5, BTX treatment). Others were found to be more complex due to involving many steps, having extensive internal and external interactions, and exhibiting numerous backwards loops or iterations (see Figure 5, Audiology). The clinic's guiding principle for designing those 25 patient processes is based on four considerations: medical sub-specialty (e.g. Oto, Rhino, Phoniatrics, Audiology, Speech Therapy, or Tumour), urgency (e.g. acute, semi-acute, cancer, or planned), patient-specific needs and unusual symptoms, and specific care processes. However, the organisation also revolves around six medical teams, each responsible for one to five patient processes. The design of the main track focuses on the most common patient groups, thereby allowing rare patient groups to deviate from the main track as needed. The more unique or rare a patient's symptoms, the more deviations or sidetracks are required within the process. As a result, some processes are comprehensive, iterative, and nested, whereas others are shorter or standardised, with fewer sidetracks or iterations. Furthermore, each process's design depends heavily on insights from a few clinicians who manage them based on their long-term experience and professional networks. Clinicians also tend to view the complexity inherent in their patient processes as necessary for taking a holistic approach to meeting each patient's needs.

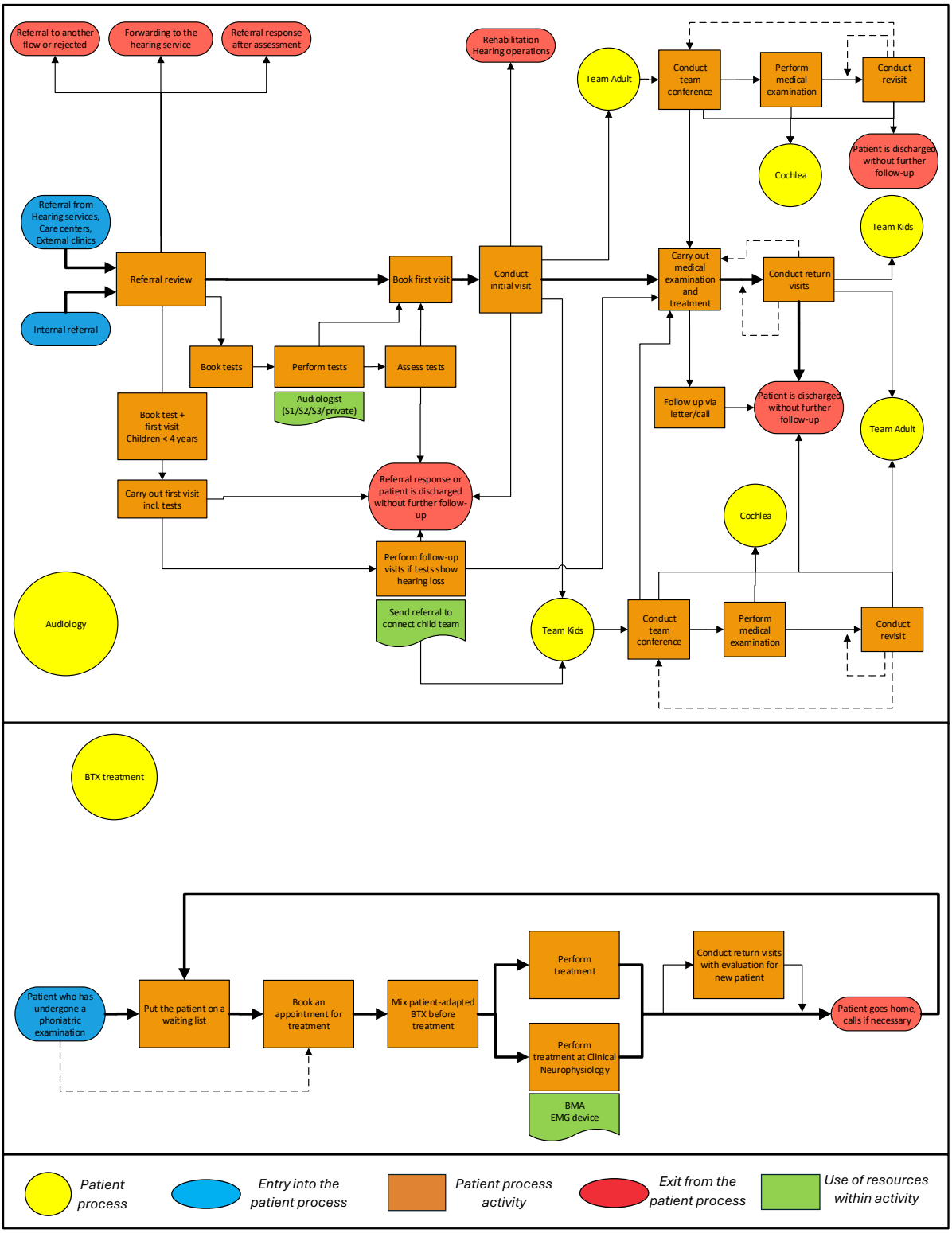
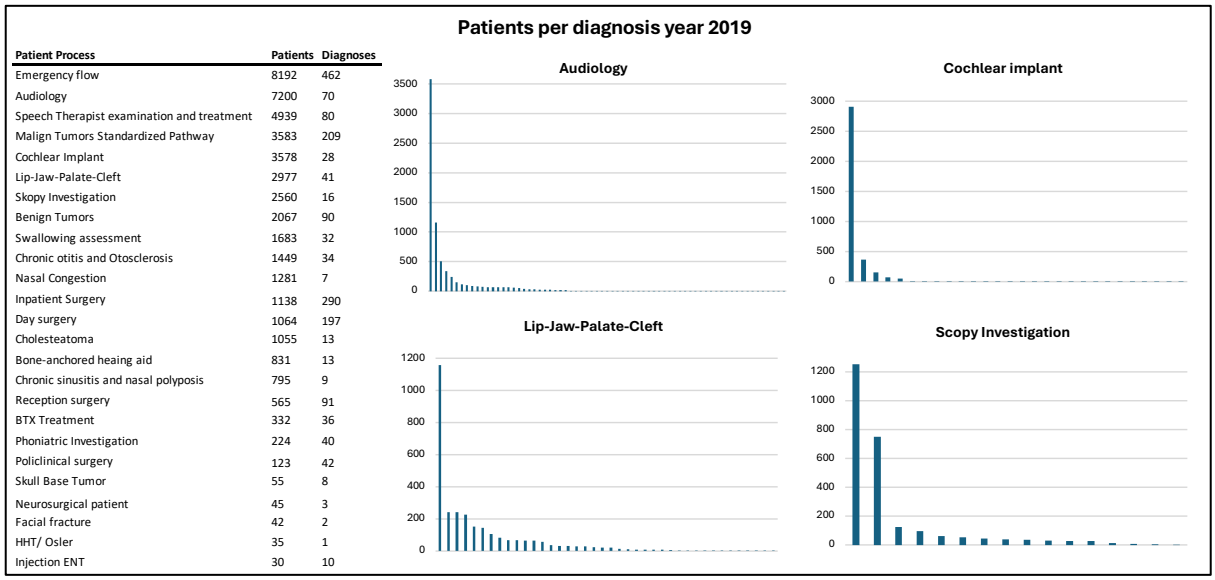


Figure 5: Patient process maps in the ear, nose, and throat clinic (i.e. the two processes Audiology and BTX treatment)

The number of patients treated per process was found to vary significantly, ranging from 30 to 8192 per year (*Mdn* = 1064), whereas the number of diagnoses per process ranged from 1 to 462 (*Mdn* = 34), as shown in Figure 6. Consequently, the least busy process cares for fewer than one patient per week, whereas the busiest handles 158 patients weekly. Most of the 25 patient processes involve an array of diagnoses, which suggests substantial diversity among patients. However, one or a few diagnoses are often overrepresented, as illustrated in Figure 6, which depicts the distribution of all patient visits per diagnostic code for four of the clinic's high-volume processes. As shown, significant variety exists in patient volumes and diagnoses across the clinic's processes, wherein large-volume patient groups are combined with multiple small-volume groups. That dynamic suggests

the challenging operational task of providing efficient care to highly diverse patient populations with varying needs. Higher throughput could be achieved by dividing existing processes into multiple pathways, especially by isolating common, homogeneous patient groups into standardised high-volume, low-variety processes and grouping uncommon patient groups into low-volume, high-variety processes requiring greater flexibility and more expansive skill sets. As for the number of patients per diagnosis within each patient process, there is a trend showing that larger volumes are associated with greater numbers of diagnoses (see Figure 6). That result suggests that high-volume flows typically exhibit a high variety of patients and complex care processes, whereas low-volume flows exhibit less variety among patients.



Patient Process	Patients	Diagnoses
Emergency flow	8192	462
Audiology	7200	70
Speech Therapist examination and treatment	4939	80
Malign Tumors Standardized Pathway	3583	209
Cochlear Implant	3578	28
Lip-Jaw-Palate-Cleft	2977	41
Skopy Investigation	2560	16
Benign Tumors	2067	90
Swallowing assessment	1683	32
Chronic otitis and Otosclerosis	1449	34
Nasal Congestion	1281	7
Inpatient Surgery	1138	290
Day surgery	1064	197
Cholesteatoma	1055	13
Bone-anchored heaing aid	831	13
Chronic sinusitis and nasal polyposis	795	9
Reception surgery	565	91
BTX Treatment	332	36
Phoniatric Investigation	224	40
Policlinical surgery	123	42
Skull Base Tumor	55	8
Neurosurgical patient	45	3
Facial fracture	42	2
HHT/ Osler	35	1
Injection ENT	30	10

Figure 6: Volume and variety of patients at the ear, nose, and throat clinic

4.2.2 Evaluating operational focus

The FHO framework consists of three major elements: defining strategic focus, evaluating operational focus, and designing and implementing focus. Our study included only the first two elements, because applying the third step was beyond its scope. Our analysis of the first element, defining the strategic focus of the clinic, revealed it to be a typical full-service clinic, one aiming to be everything to everyone. It serves the entire population (**1A**) within the hospital's catchment area; handles all levels of urgency (**1B**), from emergency cases to elective procedures and chronic conditions; treats a wide range of ENT-related diseases and symptoms (**1C**) in collaboration with other providers; adheres to clinical protocols for all patient groups (**1D**), including nationally standardised cancer pathways; and focuses on long-term outcomes (**1E**) while also coordinating with multiple providers to address patients' broader social, economic, and societal needs. The clinic's strategic direction is typical of most full-service clinics, such that adopting a narrow strategic focus remains challenging.

The second element of the framework addresses a healthcare providers current operational focus. Following Bredenhoff et al. (2010) and consistent with theories on operational focus (Hayes and Wheelwright, 1979), we distinguished categories of process focus and categories of product focus—for our context, denoted "patient focus". The only article included in the review that offers a measurement instrument is that of Bredenhoff et al. (2010), who adapted Pesch and Schroeder's (1996) frequently tested, industry-developed instrument for measuring operational focus to a healthcare context. The instrument is a questionnaire on which participants provide subjective ratings for each focal category based on their knowledge of their organisation. Although the instrument offers guidance in some areas, it lacks an objective, unbiased approach to measuring each category, which was our aim. For that reason, we chose to measure each area of focus (**2A**–**2J**) using the information given in the care maps and the extracted patient visit data (see Figure 7). For measuring the number of diagnoses (**2D**) and patient groups (**2A**) within each process, the patient's visit data were used together with the International Classification of Diseases (ICD; (World Health Organization, 2023). The first level of ICD codes indicates unique diagnoses, whereas the second level indicates patient groups. For the remaining categories, the information given within each care map was used for measurement. Arrival categories (**2B**) were determined by the number of types of patient arrivals; care process steps (**2C**) by the number of steps in the main process; specialist or medical areas (**2E**) by the number of medical areas involved, both internally and externally; interventions or treatments (**2F**) by the number of physical interventions in the care maps; and process complexity (**2H**) by the number of deviations from the main process. Patient complexity and risk (**2G**) were assessed using an average of categories **2B**, **2E**, **2F**, and **2G**. Last, the involvement of subspecialties and external providers in each patient process was used to

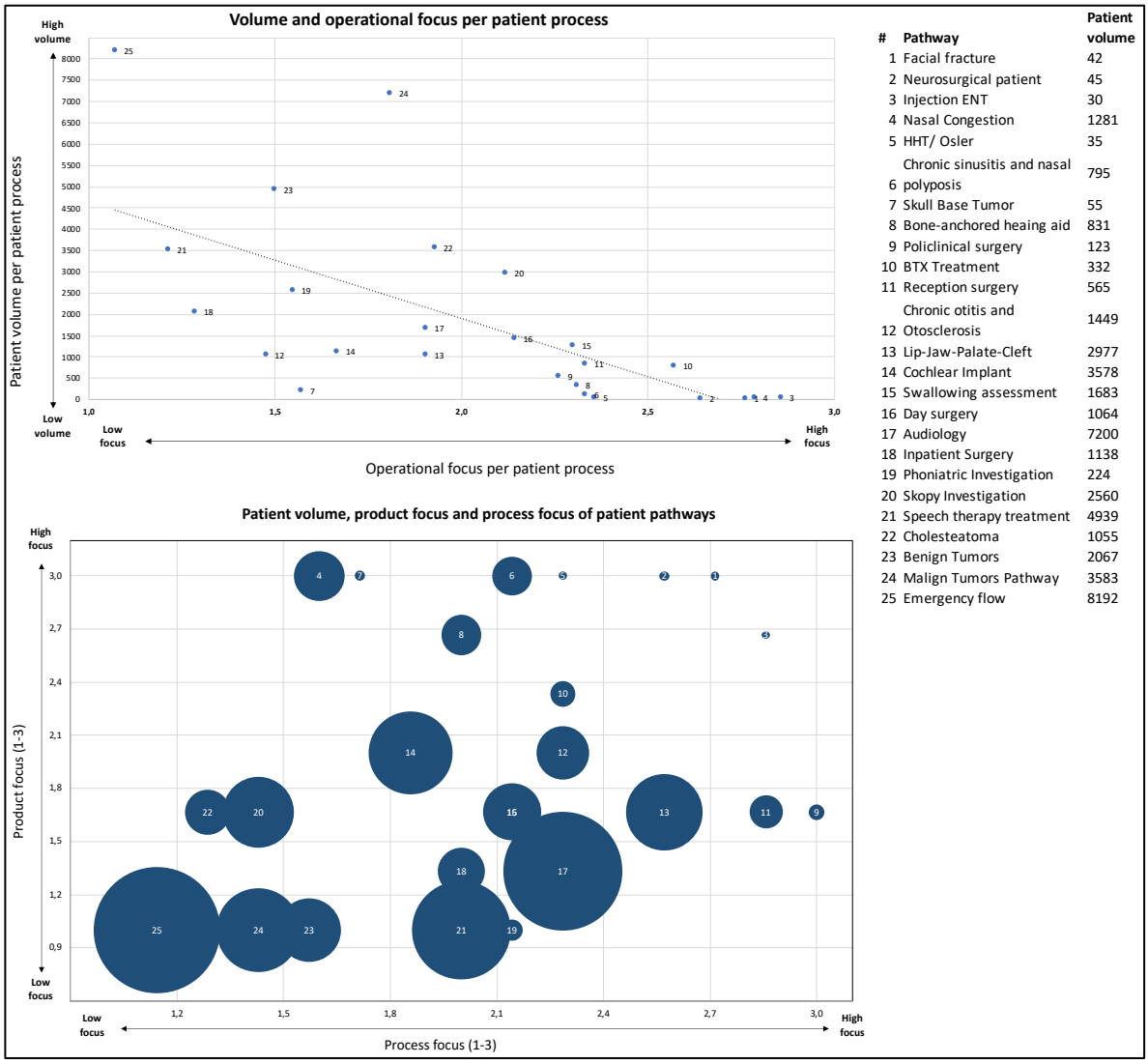
measure shared or divided physical space (**2I**) and shared human and technical resources (**2J**). Once all categories were measured, they were sorted in descending order, such that categories with a number ending in the lower third (i.e. indicating higher relative focus) received a focus score of 3, ones in the middle a score of 2, and ones in the upper third (i.e. indicating lower relative focus) a score of 1, as shown in Figure 7. After that, the categories were divided into ones related to process focus and ones related to patient focus, and an average focus score was calculated for both. Last, a total focus score was derived by calculating the average of all categories combined.

Focus Type	Process focus															Patient focus							Total focus score
Focus Categories	B		C		E		F		H		I		J		Process focus average score	A		D		G		Patient focus average score	
	Arrival categories		Process steps		Medical areas		Interventions		Process complexity		Shared physical space		Shared resources			Patient groups		Diagnoses		Patient complexity			
Focus ranges (1-3)	<2 = 3 / >4 = 1		<5 = 3 / >9 = 1		<3 = 3 / >4 = 1		<4 = 3 / >5 = 1		<4 = 3 / >6 = 1		<4 = 3 / >5 = 1		<4 = 3 / >5 = 1			<8 = 3 / >18 = 1		<13 = 3 / >36 = 1		<5 = 3 / >6 = 1			
Patient Processes	Amount	Focus Score	Amount	Focus Score	Amount	Focus Score	Amount	Focus Score	Level	Focus Score	Level	Focus Score	Level	Focus Score		Amount	Focus Score	Amount	Focus Score	Amount	Focus Score		
Facial fracture	1	3	5	3	2	3	2	3	3	3	5	2	5	2	2,7	1	3	2	3	1	3	3,0	2,9
Neurosurgical patient	1	3	3	3	3	2	2	3	1	3	5	2	5	2	2,6	2	3	4	3	4	3	3,0	2,8
Injection ENT	1	3	7	2	2	3	3	3	2	3	1	3	1	3	2,9	9	2	10	3	3	3	2,7	2,8
Nasal Congestion	3	2	8	2	1	3	4	2	3	3	5	2	5	2	1,6	4	3	7	3	4	3	3,0	2,3
HHT/ Osler	2	3	7	2	4	2	3	3	4	2	4	2	4	2	2,3	1	3	1	3	4	3	3,0	2,6
Chronic sinusitis and nasal polyposis	2	3	6	2	3	2	4	2	5	2	5	2	5	2	2,1	4	3	9	3	4	3	3,0	2,6
Skull Base Tumor	5	1	6	2	5	1	4	2	5	2	5	2	5	2	1,7	6	3	8	3	4	3	3,0	2,4
Bone-anchored heaing aid	4	2	6	2	4	2	4	2	4	2	5	2	5	2	2,0	7	3	13	2	3	3	2,7	2,3
Policlinical surgery	1	3	5	3	2	3	1	3	1	3	1	3	2	3	3,0	25	1	42	1	3	3	1,7	2,3
BTX Treatment	1	3	6	2	2	3	2	3	2	3	6	1	6	1	2,3	18	2	36	2	3	3	2,3	2,3
Reception surgery	1	3	7	2	2	3	2	3	1	3	3	3	3	3	2,9	50	1	91	1	3	3	1,7	2,3
Chronic otitis and Otosclerosis	2	3	6	2	2	3	5	2	4	2	5	2	5	2	2,3	11	2	34	2	6	2	2,0	2,1
Lip-Jaw-Palate-Cleft	1	3	5	3	4	2	4	2	4	2	1	3	1	3	2,6	11	2	41	1	6	2	1,7	2,1
Cochlear Implant	1	3	10	1	5	1	7	1	2	3	4	2	4	2	1,9	18	2	28	2	6	2	2,0	1,9
Swallowing assessment	3	2	8	2	3	2	4	2	12	1	1	3	1	3	2,1	26	1	32	2	5	2	1,7	1,9
Day surgery	1	3	9	2	3	2	3	3	3	3	6	1	6	1	2,1	92	1	197	1	4	3	1,7	1,9
Audiology	4	2	7	2	2	3	5	2	14	1	3	3	3	3	2,3	36	1	70	1	6	2	1,3	1,8
Operation	1	3	10	1	3	2	3	3	1	3	6	1	6	1	2,0	120	1	290	1	6	2	1,3	1,7
Phoniatric Investigation	4	2	8	2	4	2	6	1	6	2	3	3	3	3	2,1	24	1	40	1	7	1	1,0	1,6
Skopy Investigation	5	1	8	2	3	2	4	2	10	1	6	1	6	1	1,4	13	2	16	2	8	1	1,7	1,5
Speech therapy treatment	4	2	10	1	4	2	4	2	10	1	2	3	2	3	2,0	29	1	80	1	7	1	1,0	1,5
Cholesteatoma	5	1	12	1	3	2	7	1	4	2	7	1	7	1	1,3	8	2	13	2	7	1	1,7	1,5
Benign Tumors	3	2	14	1	4	2	6	1	9	1	7	1	2	3	1,6	24	1	90	1	10	1	1,0	1,3
Malign Tumors Pathway	3	2	18	1	6	1	9	1	12	1	7	1	2	3	1,4	86	1	209	1	10	1	1,0	1,2
Emergency flow	6	1	18	1	5	1	4	2	7	1	7	1	7	1	1,1	235	1	462	1	10	1	1,0	1,1

Figure 7: Evaluation of operational focus at the ear, nose, and throat clinic

Our evaluation of operational focus within the ENT clinic revealed that although some processes have a high and others a low focus, most exhibit a moderate focus, around 2.0 on a scale from 1.0 to 3.0 Because no process received the same focus score across all areas evaluated, the processes may have been focused in some areas but not in others.

Altogether, the evaluation enables an analysis of the clinic's operational focus and pinpoints areas where the focus is lower or lacking, both in general terms and for specific processes. By applying the FHO framework to the ENT clinic, we gained a deeper understanding of the clinic's complexity and variability beyond the mere number of diagnoses. To illustrate, we plotted patient volumes against the combined focus score from the framework (see Figure 8, upper graph), which shows that operational focus decreases as patient volume increases, as indicated by a trend line in the figure. That trendline suggests that complexity, process variety, and patient diversity grow as patient volumes increase. The results also indicate that patient processes with higher operational focus tend to have lower patient volumes, which implies limited benefit from their operational focus. In a second illustration (see Figure 8, lower graph), we plotted the score of "process focus" against "patient focus", wherein the size of the bubbles represents patient volumes for each process. The graph reveals significant variation in focus across both dimensions and confirms previous results showing that patient volume increases while operational focus decreases and that the most focused processes are typically low-volume ones. It also shows that some processes are focused in both dimensions, some in only one, and some in neither. Last, high-volume processes generally have a low product focus, although some exhibit a moderate focus, whereas many low-volume processes have a high product focus with moderate to high levels of process focus.



#	Pathway	Patient volume
1	Facial fracture	42
2	Neurosurgical patient	45
3	Injection ENT	30
4	Nasal Congestion	1281
5	HHT/ Osler	35
6	Chronic sinusitis and nasal polyposis	795
7	Skull Base Tumor	55
8	Bone-anchored heaing aid	831
9	Policlinical surgery	123
10	BTX Treatment	332
11	Reception surgery	565
12	Chronic otitis and Otosclerosis	1449
13	Lip-Jaw-Palate-Cleft	2977
14	Cochlear Implant	3578
15	Swallowing assessment	1683
16	Day surgery	1064
17	Audiology	7200
18	Inpatient Surgery	1138
19	Phoniatric Investigation	224
20	Skopy Investigation	2560
21	Speech therapy treatment	4939
22	Cholesteatoma	1055
23	Benign Tumors	2067
24	Malign Tumors Pathway	3583
25	Emergency flow	8192

Figure 8: Comparison of patient volumes and operational focus

5. Discussion

Improving operational focus leads to increased productivity for most healthcare organisations (Hyer et al., 2009, McDermott and Stock, 2011, Zepeda et al., 2021, Thirumalai and Devaraj, 2024). However, increasing focus for full-service healthcare providers remains challenging because they cannot avoid having a high variety of patients and complex cases that demand extensive resources and coordination (Thirumalai and Devaraj, 2024). Our framework offers a solution by allowing healthcare organisations to assess the focal level of their patient processes, which enables them to differentiate specialised from general patient groups and processes. That distinction, supported by Christensen et al. (2009) and Kuntz et al. (2019), makes it possible to identify areas lacking focus and to target specific areas for improvement. Unlike Bredenhoff et al. (2010), who relied on subjective self-assessment from healthcare professionals, our approach involved using process maps and patient visit data, all for a more objective assessment of focus. Even so, similar to Bredenhoff et al. (2010), we maintain that due to variations across medical specialties and national healthcare systems, the way of grading each category should be adapted to each specialty field. Thus, each hospital or clinic can determine how to measure those focal areas when evaluating their processes. In that light, the FHO framework not only evaluates focus but also facilitates strategic comparisons across processes, which can guide efforts to improve operational focus in healthcare.

A key insight from our study is the relationship between patient volumes and operational focus, as illustrated in the case study on the ENT clinic. As patient volume increases, so does variety, which reduces operational focus. Healthcare professionals might find that relationship to be self-evident, for increases in patient volumes often lead to more diagnostic codes, more process deviations, and the involvement of additional medical areas. However, the relationship runs counter to classical theory on ways to build efficient, productive processes (Hayes and Wheelwright, 1979, Holweg et al., 2018, Schmenner and Swink, 1998)—an area in which the ENT clinic suspects

they are unsuccessful—which suggests that as volume increases, variation should decrease (i.e. focus should be higher). Drawing on Hayes and Wheelwright (1979) and Holweg et al (2018) regarding the optimal relationship between products and processes, we visualised the relationship between patient volumes and operational focus at the ENT clinic alongside the central elements of the product–process matrix, adapted to a healthcare context (see Figure 9). The matrix illustrates that the relationship between volume and variety—in our case, focus—should move from high-volume, low-variety (i.e. high focus) along the "efficient zone" to low-volume, high-variety (i.e. low focus). Although the position of the efficient zone is only conceptual, the relationship between volume and variety, for efficient operations, has been demonstrated multiple times (Huckman, 2009, Holweg et al., 2018). At the ENT clinic, however, the trend moves from low-volume, low-variety (i.e. high focus) to high-volume, high-variety (i.e. low focus), thereby shifting from economically unviable processes—"being nothing to no one"—to professionally infeasible ones—"being everything to everyone"—as indicated by the black trend line. That finding supports arguments for breaking up some of the clinic's processes and merging others to better align with the efficient zone. However, doing so may not be feasible if diagnoses are too diverse and volumes too low. Nonetheless, the increase in queue times and decrease in patient throughput observed in healthcare settings seem to be linked to that inverse volume–focus relationship.

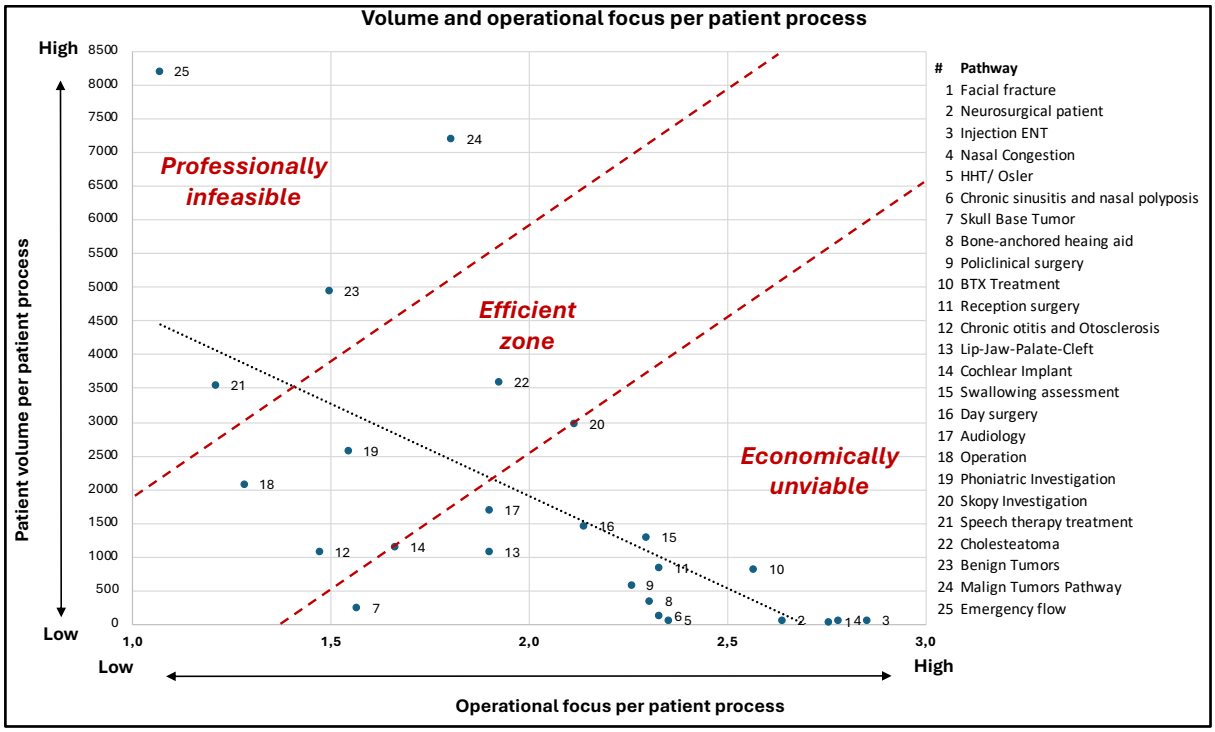


Figure 9: Efficient zone for patient volumes and operational focus

Research on operational focus in healthcare has primarily examined how productivity is enhanced by separating more easily treated patient groups from the care of complex full-service healthcare providers (KC and Terwiesch, 2011, Pieters et al., 2010, Thirumalai and Devaraj, 2024, Ding et al., 2020). Although a focused organisation may become more productive (McDermott and Stock, 2011, Ding et al., 2020), it also risks reducing the overall performance of the healthcare system if all services and elements are not adequately considered during reorganisation (Hyer et al., 2009, KC and Terwiesch, 2011, Olsson, 2020, Thirumalai and Devaraj, 2024, Ding et al., 2020). In response, we propose, as visualised in Figure 2, that healthcare providers distinguish focused healthcare facilities, service lines, and pathways from general ones. Applying that model to the ENT clinic reveals that the clinic's processes are not clearly divided into either being low-volume, high-variety (i.e. low focus) or high-volume, low-variety (i.e. high focus). Even the standardised patient pathway for cancer patients, as shown in Figure 8, is considered to be unfocused and highly complex, with significant variety in patients and processes. Such characteristics are troublesome, as Sales-Coll et al. (2021) have demonstrated, given the need for standardisation to achieve adherence to procedures, which is considered to be particularly important in cancer care.

By integrating insights from the product–process matrix and findings from the case of the ENT clinic, we developed a 2 × 2 matrix (see Figure 10) with two dimensions—process focus and patient focus (i.e. product focus)—each ranging from low to high. The matrix is overlaid on the bubble plot in Figure 8. In the upper left

corner, we identify processes characterised by a homogeneous mix of patients served by a flexible care process, labelled "Exclusive care", in which substantial resources and flexibility are allocated to a narrow group of patients. The upper right corner represents processes with a homogeneous mix of patients served by a standardised care process, termed "Focused care", with minimal variation in patients and the design of care processes. The lower right corner features a heterogeneous mix of patients served by a standardised care process, called "Untenable care", in which a narrow set of resources in a standardised process serves a highly varied mix of patients. Last, the lower left corner represents processes with a heterogeneous mix of patients served by a flexible care process, labelled "General care", in which significant resources and flexibility accommodate a wide range of patients.

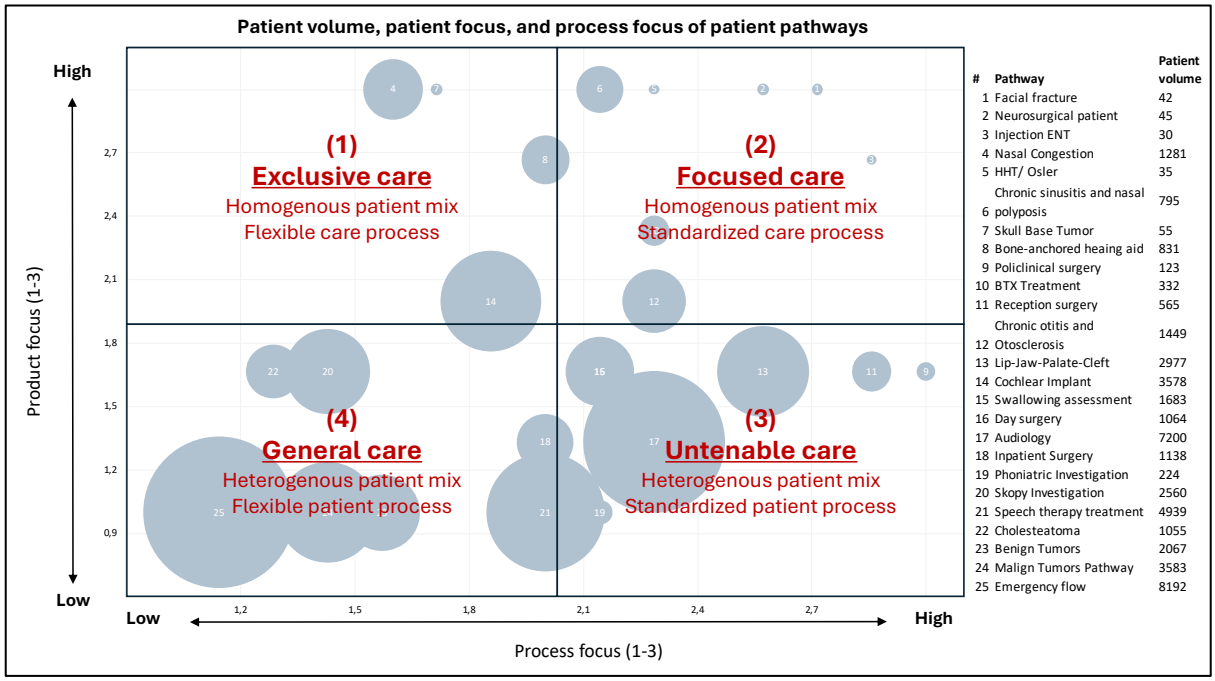


Figure 10: Four types of patient pathways

According to Hayes and Wheelwright (1979) and Holweg et al. (2018), processes should ideally fall within either "Focused care" or "General care" (i.e. squares 2 and 4). Although the ENT clinic's processes span all four categories, most processes are "General" or "Untenable", whereas few are "Exclusive" or "Focused". As a full-service clinic at a university hospital, the clinic is expected to have some "Exclusive" processes for the most complex and high-priority cases, albeit in low volumes. Likewise, emergency flows, including those in the ENT clinic's case, are expected in "General care" due to being designed to manage a high volume of diverse ENT disorders. However, most of the ENT clinic's processes fall into squares 3 and 4, with minimal presence in square 2. That result is concerning because "Focused care" typically represents the main source of revenue, in which high-volume flows are managed at lower costs. For that reason, the clinic's processes should be reorganised. The focus-related potential of the ENT clinic lies in three areas. First, high-volume "Untenable" processes can likely be split into more homogeneous groups to create focused processes, whereas the rest may form a general process that better aligns patients' needs with the design of processes. Second, high-volume "Exclusive" processes could be further standardised to align with the patient group's somewhat homogeneous, narrow needs. Third, high-volume "General" processes could aim for greater focus in parts of the process or be divided between homogeneous high-volume patient groups and heterogeneous low-volume groups.

The complex, diverse mix of patients at full-service providers often makes care delivery cumbersome, due to requiring extensive preparation for multi-morbid patients, heavy lifting for obese patients, and significant time margins for anxious and frail patients. Consequently, a workday can become highly stressful, both physically and mentally, for healthcare professionals and managers. Outsourcing simpler, more predictable care may worsen the situation and further complicate the working environment (Thirumalai and Devaraj, 2024). Therefore, it is crucial to distinguish routine, straightforward care from complex, unique cases in order to develop specialised facilities, service lines, and pathways alongside general ones, as suggested by Cook et al. (2014a). That approach allows healthcare professionals to alternate between simple, routine care and complex, unique cases, for an altogether diverse work environment that offers opportunities for improved medical quality, operational efficiency, and professional well-being. In short, because full-service providers face significant challenges in improving productivity due to the inevitable complexity of patients, the FHO framework can help them to distinguish what

care should be specialised versus general, which offers a path to improving productivity while continuing to serve a diverse patient population.

Although the FHO framework provides a structured approach for evaluating focus across patient processes, the next critical step is to use those insights to drive the redesign. One effective method to that end is value stream mapping (VSM), which can help healthcare organisations to visualise end-to-end processes, identify bottlenecks, reduce waste, and streamline flows (Marin-Garcia et al., 2021). Another complementary approach is business process reengineering (BPR), which, similar to VSM, emphasises improving processes but aims for more radical transformation and gains in performance by fundamentally rethinking existing practices (Abdolvand et al., 2008). By mapping current patient journeys in both focused and unfocused areas, healthcare providers can identify inefficiencies that reduce focus, including unnecessary handoffs, redundant diagnostics, unbalanced resource allocation, and/or excessive wait times. Integrating VSM and BPR with the FHO framework also affords a more action-oriented improvement cycle; while assessments of focus indicate areas in which to intervene, VSM and BPR clarify ways to intervene. For instance, in an ENT clinic, mapping high-volume, unfocused pathways could reveal specific opportunities to segment patient flows or eliminate non-value-adding steps, which would enhance both focus and throughput.

6. Limitations and directions for future research

A key limitation of our research is that our findings are partly based on a single-case study, which restricts their generalisability. However, the medical clinic was carefully selected to represent a full-service hospital, which enhances the relevance of our findings to other full-service healthcare organisations. Second, the literature review was based on a search for articles in only three databases, which risked overlooking articles relevant to the objective of the review. Third, we developed a framework to help healthcare organisations to define a strategy to promote focus, evaluate operational focus, and implement changes to improve their performance and productivity. Although the framework was derived from published research and applied to a single-case study, it has not been tested or implemented, which limits its validity. Fourth, although data analysis was conducted by three independent researchers, our shared background in operations management may have narrowed our perspective and introduced potential bias in our interpretations and conclusions. Last, the absence of a validated measurement instrument for assessing focus in each evaluated is also presenting a limitation. Although such an instrument would be useful, developing one adaptable to all medical contexts remains challenging, and it might be more effective for each organisation to establish its own measurement methods.

Despite research on how focus in specialised organisations can improve performance, attention to how strategic and operational focus might impact full-service healthcare providers has been limited. In response, prospective and retrospective studies on the effects of increased operational focus in full-service settings are needed, along with interventional studies, to validate the framework by assessing its applicability and usefulness. Research on developing and testing design methodologies when redesigning healthcare processes is also needed to better enhance the operational focus of full-service healthcare providers.

7. Conclusions and managerial implications

In our study, we examined how full-service healthcare providers can improve productivity by adopting more focused operational strategies, even when serving diverse, complex patient populations. Building on prior research investigating the application of the concept of the focused factory in healthcare, we developed a framework for FHOs that enables organisations to assess and refine their focal strategies and thus optimise their operational effectiveness. In particular, it helps healthcare providers to distinguish areas best served by standardised, focused processes from ones requiring more adaptable, general approaches, which ultimately allows efficiency gains without compromising the quality of care. Applying the framework to a full-service provider, we identified a paradox: that as patient volumes increase, process complexity and variation also rise. That finding contradicts classical operations theory, which suggests that higher volumes should support process standardisation and increased focus. That paradox may help to explain increased wait times for patients and the deteriorating work conditions experienced by many healthcare professionals. Our findings suggest that to successfully apply the concept of the focused factory in full-service healthcare settings, providers need to adopt a dual-focus model that is capable of handling both routine and complex cases. We advise healthcare organisations to strategically segment their services into two categories: focused care (i.e. characterised by a narrow patient mix and a low level of variation in processes) and general care (i.e. marked by a diverse mix of patients and a high level of variation in processes). The approach enables a better alignment between patients' needs and process designs. Beyond healthcare, our findings have broader implications for service organisations that do not differentiate their processes based on complexity. Without such differentiation, those settings are also subject to rising volumes that can increase variation, reduce productivity, and create unsustainable work environments.

From a managerial perspective, it is essential for healthcare leaders to recognise the need to separate low-volume, complex patient flows from high-volume, standardised ones. Clinics should therefore actively map and document patient pathways to reduce complexity and enhance transparency. In full-service healthcare settings, care processes may become so intricate that few clinicians understand them well enough to facilitate improvement. When low- and high-volume patient groups are mixed without administrative insight, improvements in productivity may become nearly impossible without significantly increasing healthcare spending. Ignoring that possibility also exacerbates the stress experienced by healthcare professionals, who are often forced to compensate by working faster within an increasingly opaque system. Indeed, many full-service healthcare providers today suffer from low productivity and high staff turnover, which makes a significant number of processes untenable or overly generalised. In response, our framework offers healthcare managers a practical instrument to assess the degree of focus in their operations, both in terms of patient segmentation and process design. By using the instrument, managers can identify areas that lack focus, implement targeted improvements, and enhance the overall productivity of their healthcare facilities.

Declaration of interest statement

The authors have no competing interests to declare.

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Appendix A:
Included papers in the review

#	Authors	Journal/Book	Year	Country of study	Setting	Study Design	Purpose	Findings
1	Bredenhoff	BMC: health services research	2010	US/Europe	Hospital	Multiple Case Study	To explore the application of the focused factory concept in hospital care, including an indication of its performance, resulting in a conceptual framework that can be helpful in further identifying different types of focused factories	Identification of three types of focused factories: specialty based, delivery based, and procedure based. Focus could lead to better operational performance, but only when clear strategic focusing decisions are made
2	Cook et al.	Health Affairs	2014	US	Chardiology Clinic	Longitudinal Pre-Post Single Case	To disrupt an adult cardiac surgical practice by creating a "focused factory" model (characterized by a uniform approach to delivering a limited set of high-quality products) within the practice's solution shop	Creating a focused-factory model within a solution shop, by applying industrial engineering principles and health information technology tools and changing the model of work, is very effective in both improving quality and reducing costs.
3	Cook et al.	Health Affairs	2014	US	Chardiac surgical clinic	Single case interventional study	To improve quality of care around indwelling bladder catheter use following surgery by creating a "focused factory" model within the cardiac surgical practice	It is possible to acheive higher compliance rate with quality metrics and significant reduction in unwarranted variation from the introduction of factory focus
4	Dabhilkar and Svarts	Operations Management Research	2019	Sweden	Hospital	Observational Single Case Study	To develop a high-level model of focus in healthcare	Focus in healthcare operations can be operationalised as a configuration model consisting of the interrelated dimensions Knowledge areas, Procedures, Medical conditions, Patient groups, Planning horizons and Levels ofdifficulty
5	De Regge et al.	Acta Clinica Belgica	2016	Belgium	Hospital	Comparative case study	To explore empirically whether the focused factory concept (i.e. of physician-owned specialized facilities) affects the patient experience by delivering better service quality than general hospitals	Service quality and patient experiences are high in both facilities. The medical center has higher service quality for interpersonal and environmental service quality and is more process-centered
6	Huckman	Harvard Business Review	2009	US	Clinic	Descriptive	To help managers address operational issues to optimize their Plant Within Plans (PWP) systems	Successful focus comes from: clear objectives, right boundaries, rules for resource sharing, and customized performance criteria
7	Hyer et al.	Journal of Operations Management	2009	US	Hospital	Pre Post Implementation Single Case Study	To enhance understanding of how a focus-based approach to organization redesign in health care affects processes and practices, and what operational, clinical, and financial outcomes result from such a change.	The success to focus depends on patient volume, process improvement and implementation management, and come with both efficiency enhancing and revenue expanding benefits
8	Peltokorpi et al.	Service Research & Innovation Institute (SRII)	2011	Finland	Surgeical clinic	Multi-case quantitative theory testing	To design, and by multi-case data, evaluate a model to characterize the focus concept in healthcare services	Focused hospital units (FHU) utilize more capacity, are more labout intense, and have lower throughput.
9	Peltokorpi et al.	International Journal of Health Care Qualtiy Assurance	2015	Finland	Hospital	Theoretical paper	To discuss strategic options to focus health care operations	Presents a model to define focus and identifies five focus strategies, their advantages and challenges
10	Pieters et al.	International Journal of Operations & Production Management	2010	The Netherlands	Outpatient Clinic	Quantitative Single Case Study	To report on a study investigating the limits of the applicability of the focused factory concept (FFC) in health care.	For systems where it is hard to separate simple and complex patients consistently and reliably FFC does not align well
11	Vissers	International Series in Operations Research & Management Science	2006	The Netherlands	Chardiology Clinic	Qualitative Single Case study	To propose a sustainable logistics approach for hospital process management as an alternative to traditional quality management	A more fundamental approach for hospital process improvement should be used to make improvements sustainable and part of a new routine to be developed in hospitals, in which the process of patients is the basis for organizing hospitals

Paper IV

Åhlin, P., Almström, P. & Wänström, C. Operationalizing hospital-wide patient flow: A multiple-case study of leading academic hospitals. Currently under review at the *Journal of Operations Management*, a previous version previously presented at EurOMA conference 2024

Operationalizing hospital-wide patient flow: A multiple-case study of leading academic hospitals

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Abstract
Hospitals face growing pressure to meet rising patient demand with limited resources, making efficient hospital-wide patient flow a critical operational challenge. While prior research has examined patient flow from various perspectives, little is known about how flow is operationalized in practice and how decision-making structures enable responsiveness. This study investigates how hospitals allocate decision-making authority to manage patient flow, focusing on what decisions are made, where they are made, and by whom throughout daily operations. Drawing on an international multiple-case study of five leading academic hospitals, including site visits and in-depth interviews with managers and healthcare professionals, this study reveals that hospital operations require fundamentally different approaches to planning and control compared to those in manufacturing industries. Rather than following a strict hierarchy of centralized plans executed locally, hospitals rely on continuous rebalancing of resources and the reprioritization of patients across interdependent units. Decision-making remains predominantly decentralized, enabling frontline responsiveness and safeguarding patient safety, yet hospitals are increasingly experimenting with centralized coordination mechanisms such as command centers. We develop a framework that extends the traditional dichotomy of planning and control by introducing two additional modes of decision-making: locally aggregated rebalancing and centrally detailed reprioritization. This framework highlights how hospitals combine professional autonomy with selective centralization to maintain flow under volatile demand and shrinking operational margins. The findings contribute to operations management theory by reconceptualizing centralization as trust-based facilitation rather than hierarchical control, and by documenting the emerging organizational shift toward hospital-wide coordination supported by data-driven insights, predictive analytics, and proactive flow management.

Keywords: Decision-making, Operations, Planning and Control, Solutions, Productivity, Efficiency, Command Center

1. Introduction

The demand for healthcare services continues to outpace capacity, driven by demographic changes and rising multimorbidity (WHO, 2024). As hospitals account for the largest share of healthcare expenditures (OECD, 2024), improving operational efficiency has become a priority. A key approach to achieving this goal is improving patient flow, which is described as the coordinated progression of patients through healthcare facilities (Åhlin et al., 2023, Gualandi et al., 2019, Johnson et al., 2020, Kreindler, 2017). Effective patient flow ensures timely access to care, optimizes the use of scarce resources, and increases throughput, often measured by reduced length of stay (LoS) (Johnson et al., 2020, Devaraj et al., 2013). Importantly, better flow also contributes to higher care quality, greater patient safety, and improved patient satisfaction (Improta et al., 2018, Lovett et al., 2016).

Yet hospitals differ from most other service industries because they operate as complex, uncertain, and interdependent systems. Healthcare delivery must accommodate multiple professional groups, unpredictable patient needs, regulatory requirements, and sophisticated technological infrastructures (Gualandi et al., 2019, Dobrzykowski and Tarafdar, 2015). Coordination requires the involvement of diverse actors, including physicians, nurses, administrative staff, and patients who work within structured but constantly evolving environments (Braithwaite et al., 2017). Variability in patient flow, resource scarcity, and emergent clinical conditions also demand real-time decision-making and organizational adaptability (Litvak and Bisognano, 2011, Lovett et al., 2016). Hospitals are therefore compelled to balance efficiency with patient-centered care, while simultaneously managing operational bottlenecks (Chen et al., 2024). Achieving this balance requires aligning departmental objectives and integrating workflow to support seamless transitions across the care continuum (Devaraj et al., 2013, Gualandi et al., 2019). However, integration is notoriously difficult in hospitals, where departments often function as semi-autonomous units and may even compete for limited resources (Glouberman and Mintzberg, 2001, Kreindler, 2017). Consequently, improving patient flow demands system-wide approaches that cut across professional and organizational boundaries, from admission to discharge (Kreindler, 2017, Litvak and Bisognano, 2011, Vissers et al., 2010).

Prior research on how to improve patient flow in hospitals has explored the issue from multiple angles, including studying performance indicators (Villa et al., 2014), paradoxes (Kreindler, 2017), Lean healthcare applications (D'Andreamatteo et al., 2015), and hospital-wide strategies (Gualandi et al., 2019, Åhlin et al., 2023). Complementing this strategic focus, another body of research has examined operational decision-making, highlighting the role of frontline professionals who make real-time choices under uncertainty. For instance, Dai

et al. (2017) documented how physicians weigh medical appropriateness against financial considerations when recommending treatments, while Ding et al. (2019) analyzed how emergency physicians triage patients under varying conditions of urgency and information complexity. These studies emphasize the importance of local, physician-led decisions in shaping patient flow. At the same time, scholars have examined how the distribution of decision-making authority influences coordination and outcomes. Goradia and Chandrasekaran (2024) showed that centralizing flow-related decisions under a single coordinator reduced LoS and improved throughput for patients with low process uncertainty. In contrast, insights from healthcare operations management (HOM) suggest that patients with more complex conditions may benefit from distributed, continuous involvement of multiple providers (Ahuja et al., 2020). These differing perspectives illustrate the inherent tension between centralized control for efficiency and decentralized autonomy for patient-centered care. Further studies highlight how organizational and professional dynamics complicate these trade-offs. Lan et al. (2022) emphasized that while structural and technological enablers matter, ultimate decisions remain in the hands of physicians at the point of care. Frangeskou et al. (2020) showed that attempts at process standardization often clash with entrenched professional decision-making practices. Similarly, Johnston et al. (2019) revealed how surgeons' preferences for scheduling autonomy may undermine broader coordination efforts, underscoring the need for data-driven tools that align individual discretion with system goals.

Taken together, this research shows that operational decision-making in hospitals is fragmented across individuals, professions, and organizational layers. Despite rich insights into specific processes and professional groups, we still lack an integrated understanding of how decision-making unfolds across the hospital as a whole. To address this gap, the purpose of this study is to explore when, where, and by whom operational decisions are made to ensure efficient hospital-wide patient flow. Rather than focusing narrowly on individuals or single processes, we examine decision-making as a system-level phenomenon. To this end, we conducted an international multiple-case study based on site visits and in-depth interviews with managers and healthcare professionals across five leading academic hospitals. In total, 157 interviews and 112 individual informants. These institutions, renowned for their clinical excellence, educational role, and research activities, provide fertile ground for studying how complex organizations manage patient flow.

Building on these cases, we develop a framework for understanding and improving hospital-wide decision-making processes related to patient flow, with recommendations applicable across healthcare systems. The remainder of this article is structured as follows. Section 2 reviews the relevant literature, followed by the methodology in Section 3. Section 4 presents the within-case analysis, and Section 5 presents the cross-case analysis. Section 6 discusses the findings, after which Section 7 summarizes the study's contributions and limitations.

2. Literature Review

This section establishes the conceptual foundation for operational planning and control. Sections 2.1–2.5 outline key concepts, including the basics of operational planning and control, decision-making structures, and factors shaping decision allocation. Section 2.6 examines the trend toward centralized hospital operations through command centers. Section 2.7 introduces a hospital-wide patient flow model, providing the analytical structure for exploring how decision-making authority is allocated to improve patient throughput.

2.1 Operational planning and control

Operations management concerns the design, execution, and improvement of processes that create and deliver goods and services. It is "the activity of managing the resources that create and deliver services and products, ensuring that resources are utilized efficiently to meet organizational goals" (Slack et al., 2022). Planning occurs at strategic, tactical, and operational levels, with strategic planning setting long-term objectives, such as capacity or technology investment (Porter, 1985). Tactical planning bridges strategy and execution through medium-term resource allocation and scheduling (Chopra and Meindl, 2016). Operational planning addresses daily workflow, including staff coordination, bed assignments, and real-time adjustments (May et al., 2011, Hans et al., 2012, Hulshof et al., 2017). Managing patient flow efficiently in hospitals is a complex challenge, particularly at the operational level. Hospitals must continuously balance resource constraints, unpredictable demand, and the need to deliver timely, high-quality care (Hans et al., 2012, Hulshof et al., 2017). Emergency departments, for example, face fluctuating inflows that require rapid bed and staff allocation (Devaraj et al., 2013, Lovett et al., 2016), while surgical scheduling demands coordination of operating rooms, surgeons, and postoperative care.

Building on Anthony's (1965) framework, Vissers et al. (2023) emphasize the importance of distinguishing between structural coordination and operational coordination in managing operations efficiently. Structural coordination refers to arrangements at the strategic and tactical levels, encompassing policies, organizational structures, and resource allocations that shape how operations are conducted. Operational coordination, on the other hand, involves real-time adjustments and decision-making to ensure that workflow and resource utilization align with patient needs on a daily basis. Both can be centralized or local, and either aggregated

(system-wide flows) or detailed (individual patient care). Defining how and where decisions are made is critical for enabling efficient patient flow across hospitals.

2.2 Central or local decision-making

Operational control depends on decision-making structures, particularly whether authority resides centrally (management) or locally (frontline staff). Each approach has distinct advantages and limitations depending on the production or service context (Brownie et al., 1984, Mintzberg, 1979). Centralization supports standardization, consistency, optimized resource allocation, and economies of scale in areas such as production scheduling, inventory, and capacity planning (Altamimi et al., 2023, Chopra and Meindl, 2016, Porter, 1985, Brownie et al., 1984). However, it may reduce responsiveness and adaptability in dynamic environments, where bureaucratic delays hinder agility (Mintzberg, 1979, Son et al., 2025). Local decision-making grants autonomy and enables rapid responses, particularly in high-uncertainty contexts requiring on-the-ground expertise, such as JIT production or high-mix, low-volume systems (Ohno, 1988, Brownie et al., 1984, Katic et al., 2021). Yet, decentralization can create inconsistencies and inefficiencies if not coordinated across units (Simchi-Levi et al., 2007). A hybrid approach, with centralized capacity planning and decentralized operational adjustments, often balances efficiency with responsiveness (Altamimi et al., 2023).

2.3 Detailed or aggregated decision-making level

Another dimension concerns the level of granularity. Detailed decision-making focuses on individual units (e.g., a machine or a patient), offering precision and customization (Katic et al., 2021). In healthcare, bedside decisions require real-time, detailed control (Braithwaite et al., 2017). However, micromanaging at this level is resource-intensive and risks inefficiency. Aggregated decision-making groups units to streamline planning, useful in high-volume, standardized production such as automotive manufacturing (Womack and Jones, 1996). Aggregation enhances forecasting, workload balancing, and resource allocation but may limit adaptability in dynamic contexts like hospitals facing fluctuating inflows (Litvak and Bisognano, 2011).

2.4 Factors affecting decision-making

Decision-making in production involves determining where and at what level decision authority should reside. The placement of decision mandates–centralized or decentralized, detailed (one unit) or aggregated (multiple units)–affects efficiency, responsiveness, and coordination. By reviewing previous literature in operations management, organizational design, and production systems, four factors are particularly relevant to where decision mandates should be placed: process complexity, production environment, technology integration, and coordination needs.

- **Process complexity** – Complex, variable workflows favor local decision-making, while standardized processes suit centralized control (Brownie et al., 1984, Mintzberg, 1979, Son et al., 2025, Womack and Jones, 1996).
- **Production environment** – Stable environments support centralized, aggregated control, while dynamic settings require local responsiveness, as seen in JIT systems and emergency care (Chopra and Meindl, 2016, Litvak and Bisognano, 2011, Ohno, 1988).
- **Technology integration** – Centralized systems leverage predictive analytics for dynamic adjustments while maintaining strategic coherence (Simchi-Levi et al., 2007), whereas IoT and digital tools empower local, data-driven decisions (Chen et al., 2024, Devaraj et al., 2013, Lovett et al., 2016).
- **Coordination needs** – Highly interdependent systems (e.g., hospital patient flow, multi-site manufacturing) require centralized coordination, whereas modular or independent units benefit from local autonomy (Womack and Jones, 1996).

2.5 A framework for operational decision-making

Decision-making authority can be classified along two dimensions: central vs. local and aggregated vs. detailed (Brownie et al., 1984, Chopra and Meindl, 2016, Mintzberg, 1979). In manufacturing, central decisions often address aggregated volumes (e.g., master production schedules), while local decisions manage detailed execution (Howard et al., 1998). Centrally detailed or locally aggregated decision-making usually arises in response to production disruptions that require flexibility (Schmenner and Tatikonda, 2005).

Healthcare differs from manufacturing in its need for continual adaptation to unpredictable demand. Thus, both centrally detailed and locally aggregated decision-making are more prevalent in hospital settings (Åhlin et al., 2023, Grosman-Rimon et al., 2023, Gualandi et al., 2019). This spectrum can be represented in a two-by-two matrix (see Figure 1), which illustrates the characteristics of operational decision making at either local or central levels, and either at detailed or aggregated levels. Locally detailed decisions support responsiveness, precision, and the need for contextual knowledge, while centrally aggregated decisions support

consistency, predictability, workload balance, economies of scale, and resource optimization (Chopra and Meindl, 2016, Grosman-Rimon et al., 2023, Katic et al., 2021, Son et al., 2025).

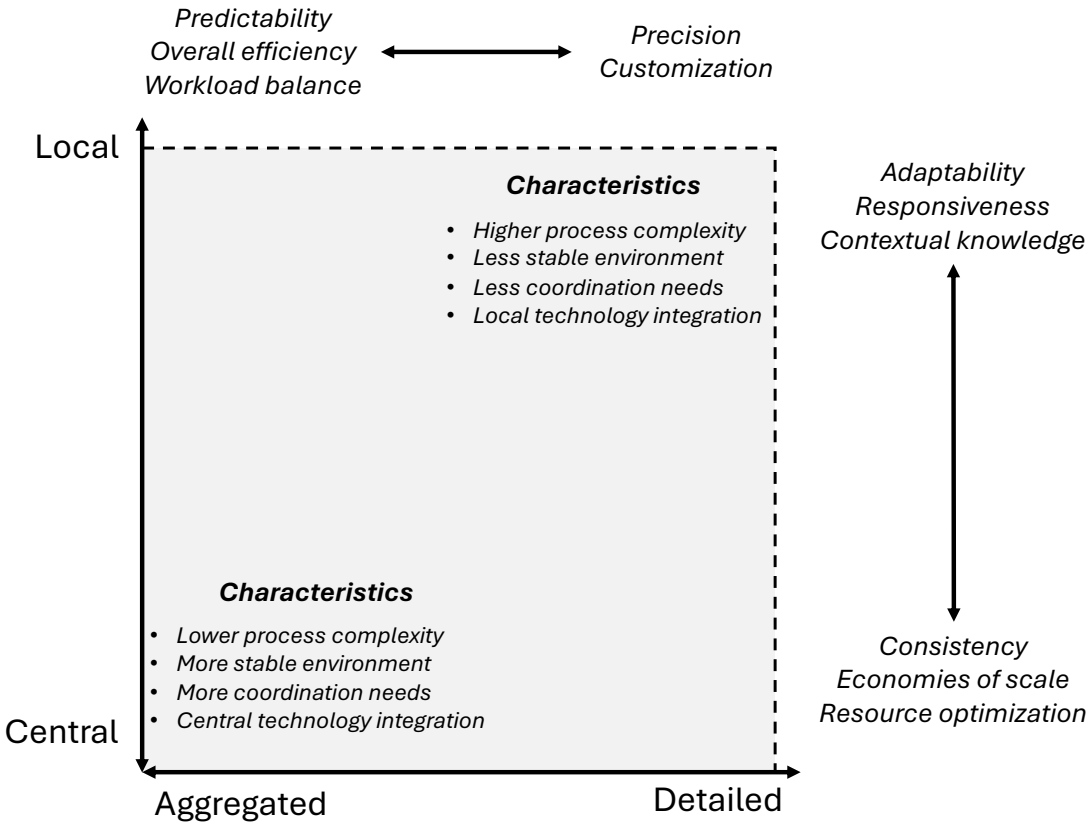


Figure 1: Characteristics of operational decision-making

2.6 Centralization of hospital operations

Hospitals operate in complex, dynamic environments characterized by fluctuating demand, constrained resources, and the need for continuous cross-departmental coordination (Litvak and Bisognano, 2011). Traditional decentralized models often create inefficiencies such as delayed transfers, uneven workload distribution, and fragmented communication (Grosman-Rimon et al., 2023, Hulshof et al., 2017, Vissers et al., 2023). To address these challenges, hospitals increasingly establish command centers, centralized units that integrate real-time data, predictive analytics, and decision-support systems to manage capacity, patient flow, and resource allocation (Franklin et al., 2022, Kane et al., 2019). This trend reflects broader shifts in healthcare operations toward centralization for oversight, standardization, and efficiency in interdependent environments (Grosman-Rimon et al., 2023, Franklin et al., 2022). Command centers perform several key functions. They (1) monitor bed occupancy and patient movements to improve admissions, transfers, and discharges, often using algorithms to predict availability (Orhan and Kurutkan, 2025, Franklin et al., 2022); (2) integrate real-time hospital data to optimize staff allocation, operating room scheduling, and emergency capacity (Grosman-Rimon et al., 2023, Kane et al., 2019); (3) coordinate responses to demand surges such as flu outbreaks or mass casualty events (Tosh et al., 2020); and (4) apply machine learning and AI to forecast admissions and identify bottlenecks (Kane et al., 2019).

The adoption of command centers offers clear benefits. Centralizing oversight enhances efficiency in transfers, resource use, and staff coordination, thereby improving hospital-wide patient flow (Franklin et al., 2022). Predictive analytics enable proactive decision-making, reducing waiting times and supporting capacity planning (Grosman-Rimon et al., 2023). Standardized workflows across departments further strengthen consistency and reduce variability in care (Kane et al., 2019). At the same time, challenges remain. Centralized coordination may constrain frontline flexibility in addressing patient-specific needs (Braithwaite et al., 2017, Chen et al., 2024, Tosh et al., 2020). Establishing command centers requires significant investment in infrastructure, IT, and specialized staff, and inflexible designs risk creating new bureaucratic delays in fast-changing environments (Mebrahtu et al., 2023). Consequently, while command centers mark a strategic shift toward centrally aggregated decision-making (Grosman-Rimon et al., 2023), they must be balanced with local autonomy to safeguard responsiveness (Mebrahtu et al., 2023). The interaction between central and local decision-making remains a critical area for both research and practice.

2.7 Introducing a process model

Productivity rests on two core principles: (a) enabling units to move swiftly through a process and (b) minimizing variation in quantity, quality, and timing (Schmenner and Swink, 1998). Their theory of swift and even flow (TSEF) posits that productivity increases with faster input flow and decreases with variability, whether stemming from demand or process steps. In healthcare, this translates to ensuring seamless trajectories of care from admission to discharge while minimizing inefficiencies and deviations (Johnson et al., 2020). Building on this reasoning, Åhlin et al. (2023), drawing on Holweg et al.'s (2018) process categories, propose a hospital-wide process model that captures the parallel and interdependent patient pathways across departments (see Figure 2).

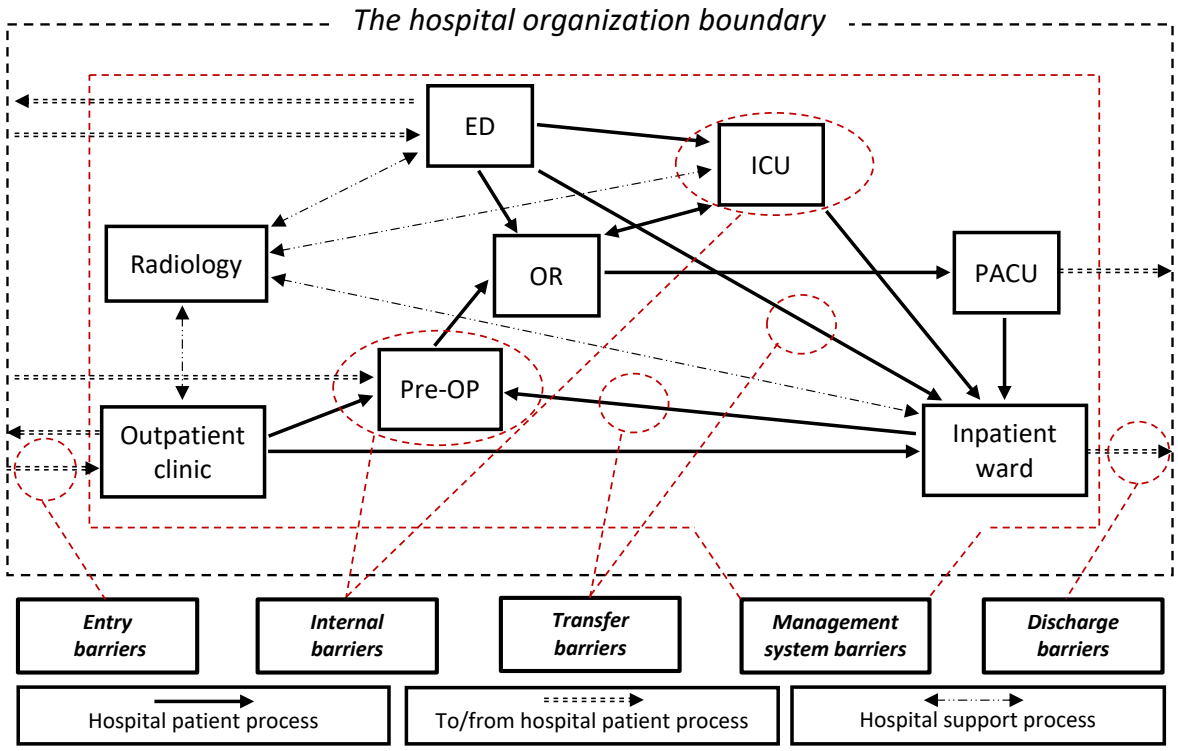


Figure 2: Themes of barriers to swift and even hospital-wide patient flow

The model highlights eight care settings: emergency department (ED), outpatient clinic, operating room (OR), intensive care unit (ICU), pre-operative unit (Pre-Op), post-anesthesia care unit (PACU), inpatient wards, and radiology. It also identifies five themes that shape hospital-wide flow and improvement strategies: entry – patient admission into the hospital; transfer – movement between clinics, units, or departments; internal – care within a specific unit; management system – hospital-wide coordination and planning; and discharge – transition to post-hospital care.

Achieving swift and even patient flows requires decision-making that continually balances fluctuating demand and available capacity. Delays or rigid procedures increase variability, prolong lead times, and hinder throughput. This study, therefore, examines how hospitals operationalize swift and even flow across the themes of entry, transfer, internal, and discharge, leaving out the management system theme, which does not directly correspond to a specific point in the patient journey. These themes provide a structure for analyzing how and where decision-making authority is allocated to improve hospital-wide throughput.

3. Methodology

3.1 Research Design

Given the limited understanding of how hospitals operationalize hospital-wide patient flow, an exploratory multiple-case study was deemed appropriate. This approach is well-suited for addressing "why" and "how" questions in underexplored contexts (Eisenhardt, 1989, Yin and Campbell, 2018) and is increasingly adopted in operations management research (Hancock et al., 2021). To enhance the robustness of the findings, we employed a multiple-case study approach, as evidence derived from multiple cases is generally more compelling and reliable than evidence from a single case (Yin and Campbell, 2018).

3.2 Case Selection

Following theoretical sampling principles (Eisenhardt and Graebner, 2007), we targeted internationally recognized leading academic hospitals. This decision was made because they represent the pinnacle of complexity within the healthcare sector, given the extensive range, diversity, and volume of patients they treat while simultaneously fulfilling substantial teaching and research obligations. Consequently, they encounter more significant obstacles when striving to enhance their processes compared to other healthcare organizations. Despite this, they generally achieve superior medical performance (Cooper, 2021, Jha et al., 2005), likely due to advanced flow logistics (Improta et al., 2018, Lovett et al., 2016). Leading academic hospitals also face considerable external pressure to maintain high performance, as they receive substantial government and public funding to support their research and educational missions. Because of this, leading academic hospitals may offer more generalizable insights that are applicable to hospitals with less complex organizational structures, and their approaches to operationalizing efficient hospital-wide patient flow are, therefore, of particular interest. To identify leading academic hospitals, the 2020 international hospital ranking by the American magazine *Newsweek* was used (Cooper, 2021), which is widely recognized, and presents an annual list of hospitals and medical clinics around the world based on recommendations from medical experts (doctors, hospital managers, healthcare professionals), patient surveys, and central medical KPIs. Following the guidance of Eisenhardt and Graebner (2007), the goal was to select a diverse set of hospitals belonging to different healthcare systems across both the US and Europe. Consequently, an initial inquiry was sent to 15 of the world's leading hospitals according to the *Newsweek* list (Cooper, 2021), whereupon five hospitals (three American and two European) agreed to participate.

3.3 Data Collection

In each case, in-depth, semi-structured interviews served as the primary data collection method, complemented by on-site observations and the examination of archival documents. The interviews were guided by a structured interview protocol (see Appendix A) to ensure comparability across interviews and cases while maintaining openness to novel ideas and perspectives (Kvale, 2007). At each hospital, a main contact person (MCP) was designated, ranging from vice presidents to patient flow development managers. The purpose of the study was presented to the MCP, and in collaboration with this person, a tailored data collection framework was established for each hospital. The data collection process adhered to a consistent structure across all cases. It began with a series of pre-visit interviews, followed by a comprehensive one-week on-site visit, and occasionally concluded with follow-up interviews if necessary. Before each hospital visit, the MCP identified four to six key individuals involved in the daily management of patient flow across the institution, with whom pre-visit interviews were held. Following these initial interviews, discussions were held with the MCPs to determine the most effective design for the on-site visit to fulfill the study's objectives. Perspectives and recommendations from the pre-visit interviews also informed the design. Upon finalizing the design, each hospital was visited for a full working week, during which 20 to 29 interviews were conducted per institution. The majority of interviews were held with managers at various levels, although a small number of healthcare professionals without managerial responsibilities were also interviewed. Observations and interviews were continuously conducted in all areas central to the operationalization of patient flow across the hospital. These included emergency departments, operating rooms, inpatient wards, intensive care units, radiology departments, outpatient centers, and central flow coordination hubs. The pre-visit interviews, including those with the MCPs, were conducted for all cases between April 24, 2022, and February 3, 2023. The subsequent on-site visits and follow-up interviews were conducted between February 13, 2023, and June 29, 2023. Altogether, 157 interviews were conducted with 112 individual informants across the five hospitals. See Table 1 for an overview of all interviews and on-site visits for each case.

Table 1: Overview of interviews

#	Hospital	MCP interviews	Pre-visit interviews	On-site visits	# on-site interviews	Follow-up interviews
1	Case K	2022-06-23	2022-10-06 2022-10-07 2022-11-08 2022-11-22 2022-11-30	**2023-02-13** to **2023-02-17**	20	2023-05-11 2023-05-23
2	Case M	2022-04-27	2022-10-04 2022-10-05 2022-10-27 2022-11-07	**2023-03-06** to **2023-03-10**	23	2023-05-10 2023-05-30 2023-06-07
3	Case U	2022-05-13	2022-10-13 2022-10-17 2022-11-09 2022-12-07 2022-12-14	**2023-04-03** to **2023-04-07**	22	2023-06-05
4	Case J	2022-06-13	2022-09-15 2022-09-29 2022-10-12 2022-10-13 2022-10-27	**2023-04-17** to **2023-04-21**	29	2023-05-24 2023-06-20
5	Case A	2022-09-08	2022-12-07 2022-12-21 2023-01-18 2023-02-03	**2023-06-12** to **2023-06-16**	26	2023-06-29

To ensure the validity of the data, we used multiple investigators for investigator triangulation and multiple informants for data triangulation (Yin and Campbell, 2018). First, while only one author of the paper conducted the on-site visits and interviews, a continuous dialogue was held with the second author before and after days of data collection, and before and after many interviews to mutually reflect upon the outcome and strategy going forward. A third author then examined the data from a third-party perspective. This setup helped mitigate potential investigator bias. To comply with the "24-hour rule" (Eisenhardt and Graebner, 2007), case study reports for each hospital were written based on the notes immediately after each day of visits.

3.4 Data Analysis

All interviews were recorded and transcribed verbatim. Subsequently, all authors reviewed the transcripts to familiarize themselves with the data before thematizing it to develop a comprehensive understanding. One of the authors (PÅ) conducted open coding of the verbatim transcripts in line with Braun and Clarke (2006), aiming to capture all perspectives relevant to the study's purpose. This process yielded a large number of unique elements, resulting in 2,615 distinct coded text segments. In a second round of coding, each coded text segment was assigned two or three short keywords that encapsulated its main characteristics, ultimately producing 450 keywords, allowing for multiple thematic connections and easier retrieval. This approach was chosen to ensure that each text segment was not confined to a single thematic category or explanation, while also facilitating the retrieval of relevant content for further analysis. The primary objective of this study was to examine how hospitals operationalize patient flow by exploring what decisions are made, where they are made, and by whom. Accordingly, keywords related to "responsibility," "prioritization," "decision-making," "mandate," "operations," "management," and "leadership" were specifically searched for in the data. As a result, between 70 and 90 relevant decisions concerning patient flow progression were identified for each case.

Once all keywords related to decisions for patient flow progression had been identified and consolidated into a single dataset, the thematic framework developed by Åhlin et al. (2022) for analyzing barriers to hospital-wide patient flow was applied. Decisions were categorized by the aspect of patient flow they addressed: entry (related to patient admission to the hospital); internal (concerning activities within hospital settings); transfer (regarding patient transfers between hospital settings); and discharge (pertaining to patient discharge and the steps leading up to it). Following Vissers et al.'s (2023) operational coordination framework, decisions were further classified by scope. Decisions made within a specific hospital setting were classified as local, while those made at a higher level, affecting multiple settings, were classified as central.

Additionally, decisions were distinguished based on their level of granularity: those concerning individual patients were labeled as detailed, whereas those addressing multiple patients were labeled as

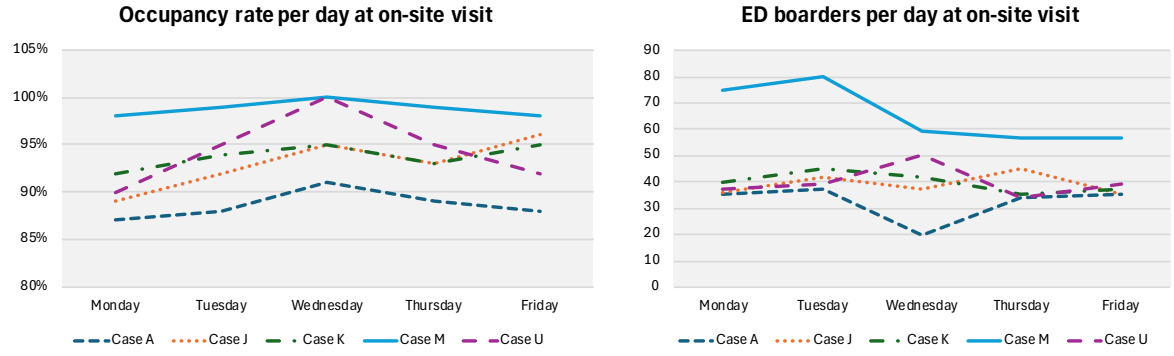
aggregated. See Appendix B for an overview of the categorization of decisions. Next, for each hospital case and each patient flow barrier theme, decisions were analyzed across the four resulting categories: (1) centrally detailed, (2) centrally aggregated, (3) locally detailed, and (4) locally aggregated. The proportion of decisions in each category was then calculated and presented in percentage brackets (0%, >0–20%, 21–40%, 41–60%, 61–80%, 81–100%) to provide a quantitative overview of decision-making distribution across hospitals and flow barriers. Finally, the complete set of themes derived from the interviews, along with observations and supporting documents, provided case-specific insights and additional perspectives for analyzing hospital-wide patient flow decision-making.

4. Within-case analysis

To explore each hospital as a distinct entity, a within-case analysis was conducted (Eisenhardt, 1989) to identify organization-specific factors influencing hospital-wide patient flow decision-making. Given the embedded unit of analysis, operational decision-making, we followed Yin and Campbell (2018) by first examining organization-level attributes, including hospital type, size, and catchment area. Next, we assessed several organizational dimensions related to the centralization of decision-making authority. These included: type of flow coordination unit; frequency and scope of hospital-wide capacity meetings; procedures for patient placement, transfers, and crisis response; and coordination of OR scheduling and patient progression. To contextualize patient volume during site visits, we also reviewed each hospital's occupancy rate and average daily number of ED boarders. Each dimension was classified as either centralized or local, based on where decision-making authority resided. Dimensions were considered centralized if authority was held by a unit with a hospital-wide mandate, and local if it was delegated to units managing specific areas of patient flow. Table 2 summarizes the organizational characteristics examined across cases.

Table 2: Key characteristics of the case study hospital units

Categories	Case A	Case J	Case K	Case M	Case U
Type of hospital	Public	Private non-profit	Public	Private non-profit	Public
Size of hospital	1150 beds & 10.000 employees	1020 beds & 10.900 employees	1059 beds & 16.300 employees	1065 beds & 13.500 employees	1043 beds & 26.200 employees
Catchment area	Small-sized city & surrounding region	Large metropolitan catchment area	Medium-sized city & surrounding region	Large metropolitan catchment area	Medium-sized city & surrounding region
Flow coordination unit(s)	One ED connected hub	One command center	Multiple local units	One command center	One command center
Hospital-wide capacity meetings	One daily	Five subsequent daily	One weekly	Five subsequent daily	Four subsequent daily
Patient placement decisions	Centralized	Centralized	Local	Centralized	Centralized
Patient transfer decisions	Centralized & adhoc	Centralized & Daily huddle	Centralized & adhoc	Centralized & Daily huddle	Centralized & Daily huddle
Decision to exceed capacity	Hospital flow coordinator	Central command center	Hospital flow coordinator	Central command center	Central command center
OR schedule coordination	Local	Centralized	Local	Centralized	Centralized
Patient progression expedition	Local	Moderate central support	Local	Moderate central support	High central support



4.1 Case A

Hospital A is a public, university-affiliated hospital serving a medium-sized city and surrounding region, with specializations in cardiology, oncology, and emergency care. Operating under a national universal healthcare system, it is funded by regional health authorities and regulated by the national health authority. The hospital

employs a centralized management structure with three administrative levels, promoting clinical independence and multidisciplinary collaboration. The ED is integrated with specialized inpatient units and accepts patients via traditional ED admissions and direct referrals from primary care and other hospitals. Bed allocation is centrally managed through a digital system overseen by a hospital flow coordinator, with ward-level counterparts. Internal transfers are coordinated during daily hospital-wide capacity meetings. Surgical scheduling is managed by surgical clinics in collaboration with the perioperative clinic but lacks centralized oversight. Discharge planning involves coordination with primary care and social services. A clinical logistics system linked to the EHR supports patient flow tracking and optimization. A mobile-accessible digital task system enables nurses to prioritize tasks for porters and cleaning staff in real time. Two project leaders oversee patient flow, one for overall hospital operations and one for surgical flow.

4.2 Case J

Hospital J is a private, nonprofit, university-affiliated hospital serving a large urban region, specializing in trauma, neurology, oncology, and cardiac care. It operates under national healthcare policies and regional regulations. The hospital has a centralized management structure, with a capacity management office overseeing strategic and operational resource allocation. The ED manages general admissions and collaborates with inpatient wards for trauma, stroke, and cardiac care. Bed management and patient placement are coordinated through a centralized command center integrated with the EHR. Coordinator counterparts exist in the ED, medicine, and surgery. Internal transfers are managed by the command center and facilitated through both local and hospital-wide meetings. Surgical scheduling is handled by surgical clinics and the perioperative clinic, with strategic oversight from the capacity office and operational oversight from the command center. Discharge planning involves coordination with primary care and community services, supported by case managers who address financial concerns. A physician serves as medical director of the command center, strengthening clinical integration. A dedicated physician group prioritizes ICU admissions, and a growing team of clinical expeditors actively resolves bottlenecks in patient progression and discharge.

4.3 Case K

Hospital K is a public, university-affiliated hospital serving a large city and surrounding region, with specializations in trauma, oncology, and organ transplantation. It operates under a universal healthcare system, publicly funded and regulated by national and regional health authorities. The hospital follows a centralized management model with five administrative levels, structured into thematic divisions that grant autonomy to individual clinics. The ED is integrated with specialized inpatient units and supports both emergency admissions and early discharges. Bed management is decentralized, with bed coordinators assigned to each division, reporting to rotating nurse managers responsible for hospital-wide capacity. Ward-level flow coordinators collaborate with bed coordinators to assess real-time capacity. Internal transfers are managed by a hospital flow coordinator and discussed in daily capacity meetings. Surgical scheduling is managed by surgical clinics and the perioperative clinic, without central coordination. Discharge planning is closely coordinated with primary care and social services. The hospital has implemented flow teams in several units, consisting of nurse and physician leaders. A strategic shift has been introduced, moving from a staffing-driven production model to a production-driven staffing model, aligning staffing levels with daily operational needs.

4.4 Case M

Hospital M is a private, nonprofit, university-affiliated hospital serving a large regional catchment area. It operates under national and regional regulations and offers comprehensive care across specialties such as trauma, cardiology, and oncology. The hospital follows a centralized management model, with a capacity coordination center responsible for both strategic planning and daily operational efficiency. The ED supports rapid admissions and discharges, integrating with specialized units for trauma, stroke, and cardiac care. Bed management and patient placement are centrally coordinated through the capacity center, supported by digital systems integrated with the EHR and ward-level flow coordinators. Internal transfers are managed by the center and facilitated through sequential local and hospital-wide meetings. Surgical scheduling is handled by surgical clinics and the perioperative clinic, with strategic and operational oversight from the capacity center to prevent congestion. Discharge planning involves collaboration with primary care and community services, supported by case managers who address financial concerns. The hospital is implementing EHR-integrated chat tools to streamline communication and transfers. A new tool highlights the five patients closest to discharge in each ward, helping staff prioritize discharges. A triad leadership model, nurse, physician, and administrative manager, has been introduced at the capacity center. Outpatient clinics are being centralized with standardized workflows and decision trees to improve scheduling and capacity management.

4.5 Case U

Hospital U is a public, university-affiliated hospital serving a medium-sized city and the surrounding region. It provides comprehensive care with specializations in oncology, cardiology, and transplantation, operating under national and regional healthcare regulations. A centralized command center oversees both long-term strategic planning and daily operational coordination to optimize capacity. The ED manages high volumes, particularly in trauma and cardiac care, and facilitates rapid admissions and discharges in coordination with inpatient units. Bed management and patient placement are centrally coordinated through the command center, supported by EHR-integrated digital monitoring and ward-level flow coordinators. Internal transfers are similarly managed and facilitated through sequential coordination meetings. Surgical scheduling is conducted by surgical clinics and the perioperative clinic, with oversight from the command center to avoid flow disruptions. Discharge planning involves close collaboration with primary care and community services, with case managers who address financial issues. The hospital has introduced an OR scheduling tool based on length-of-stay (LoS) profiles to improve downstream flow. A professional development platform for patient flow coordinators supports career advancement and service quality. A growing team of clinical expeditors works to identify and resolve bottlenecks in patient progression and discharge.

5. Cross-case analysis

The cross-case analysis was conducted by examining and comparing the placement of decision-making authority within each hospital in relation to the operationalization of hospital-wide patient flow. The analysis was carried out in two stages. First, we analyzed the overall placement of decision-making authority and the underlying rationale behind it. In the second stage, we explored how decision-making responsibilities have been distributed across different aspects of patient flow, as categorized by Åhlin et al. (2022): entry, internal, transfer, and discharge.

The within-case analysis showed that all hospitals are similar in size (measured by inpatient beds) and function as both national centers for specialized care and local community hospitals. During the site visits, all hospitals faced high demand pressure, with occupancy rates ranging from 87% to 100%, peaking midweek due to scheduled surgeries and increased ED admissions. This consistently led to a high number of ED boarders, contributing to system-wide strain. Importantly, the analysis found no clear link between hospital ownership (public vs. private) or national context and the distribution of decision-making authority. The challenges and strategies observed were broadly similar across the studied hospitals.

5.1 Structural coordination

Operational decisions to facilitate patient flow are made continuously—both during the day of service and in preceding days—across all hospital organizations. The hospitals in this study aim to balance central control with local autonomy, ensuring optimal and equitable capacity utilization while effectively distributing demand pressure. Simultaneously, they strive to maintain a rapid frontline response to patients' needs. Over the past decade, all five hospitals have undergone increasing centralization of management, a shift attributed to rising demand pressures and the need to improve patient throughput. Initially, centralization was driven by ED overcrowding and the need to distribute patient demand more evenly across departments. Today, centralized coordination extends to additional areas, particularly discharge processes, to support more efficient transitions out of the hospital.

"Each department had their own nurse assigning beds. We pulled that out of the departments and brought that group together as the bed managers. Co-locating all of those people. And that just wildly improved the efficiency of placing patients. We're still focused on bringing people in, but we now start to focus more on getting people through and out so that we better match supply and demand. And now we've just established that's the problem. We can bring them in just fine. We can't get them out. We talk a lot about care progression as the next step for the command center, who else do we need to put in the command center to manage more of the system flow making sure we eliminate barriers to care. So that is continuing to be an area where there's lots of opportunity." – [manager command center, Case J]

Despite the shared trajectory towards centralization, the hospitals differ significantly in how far they have centralized decision-making related to capacity matching and patient progression. Three hospitals—Cases J, M, and U—have established physical command centers as coordination hubs. These centers integrate multiple professional roles and previously decentralized resources. Their primary rationale is to consolidate similar functions into a single location, thereby enhancing integration across patient flow services, improving real-time hospital-wide oversight, and facilitating more efficient communication among healthcare professionals.

"Every single piece of the jigsaw puzzle has to be operating at maximum efficiency in order for everything to work. And as soon as either, you don't have enough staff in the ICU or you have patients backing up in the ED,

or you can't discharge patients from the floors or whatever that issue is. It causes everything else to slow down because those are the ingredients that are no longer there then to keep the whole model going as efficiently as possible. By centralizing the capacity coordination we can simply understand and react to imbalances more quickly" - [Chief operating officer – Case M]

In contrast, Case A has implemented a smaller centralized coordination group, located near the ED, with a hospital-wide mandate. This team is designed to prioritize the hospital's overall interests over departmental ones, enabling real-time oversight, rapid communication, and swift centralized decision-making. Meanwhile, Case K has adopted a decentralized model, with bed coordinators assigned to specific hospital sectors. Overall coordination is managed by a rotating nurse manager who is responsible for oversight decisions. Although the rationale is less explicitly articulated, it appears to emphasize sector-specific alignment and clear responsibility boundaries. The coordinating manager escalates placement issues to senior leadership and determines when the hospital should enter overcapacity mode in response to demand pressures.

The next section presents how mandate and decision-making power are distributed across the five hospitals, whether local or central, and at a detailed or aggregated level. Figure 3 illustrates the proportions of decision categories across the four patient flow themes: entry, internal, transfer, and discharge, divided into five percentage spans for each hospital.

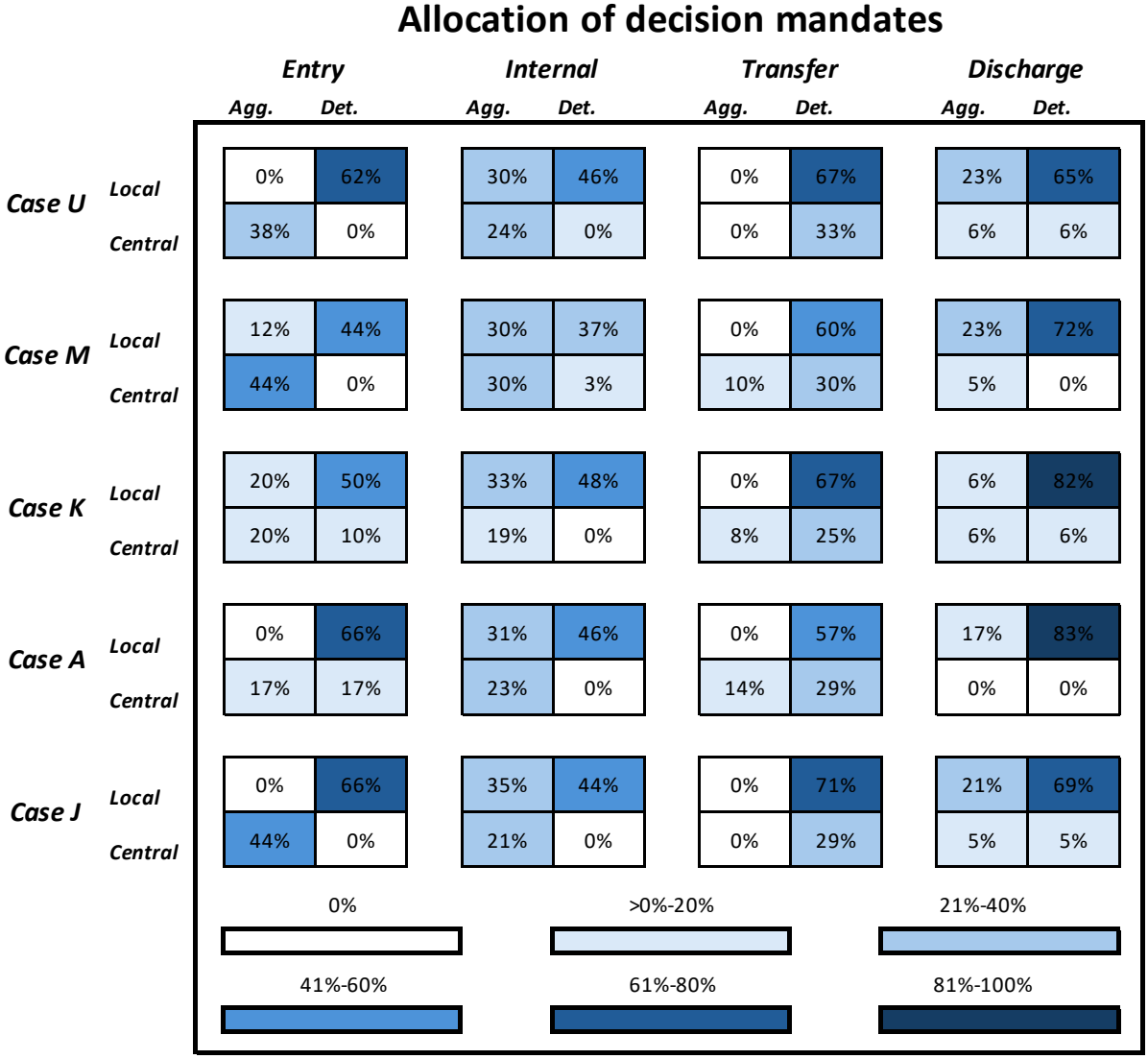


Figure 3: Allocation of decision mandates along the patient flow for all cases

5.2 Entry

Regarding entry into the hospital system, decision-making is predominantly delegated to frontline staff—physicians and nurses—at the local and detailed level, typically on a patient-by-patient basis. These decisions include prioritization for screening, triage, examinations, treatment, and eventual inpatient admission. However, during periods of hospital overcrowding, central directives may intervene to redirect patient flow. These

interventions include expanding virtual urgent care screening, discharging patients to home care programs, scheduling next-day outpatient follow-ups, or postponing surgeries to reduce immediate demand.

"We have virtual urgent cares that will screen patients for appropriateness before they ever set foot in the emergency department, so someone can connect with a provider online, get evaluated in real-time, and be guided to the right level of care. We've also expanded ambulatory access for specialty patients, which is a huge win. Rather than waiting weeks to see a specialist or bouncing back to the ED because they can't get in, these patients can now access expedited appointments. And then there's hospital care at home. For selected patients who meet clinical criteria, things like stable heart failure or cellulitis, we can actually deliver full inpatient-level care in their homes. It's safe, it's patient-centered, and it decompresses the physical hospital without compromising quality." – [Manager ED – Case M]

Central decision-making is most prominent in redirecting ambulances to other hospitals and restricting transfers from external facilities. In contrast, walk-in patient intake remains under local control. Nurses and physicians must make increasingly stringent prioritization decisions, and patients with milder symptoms may leave if wait times become excessive. Although hospital administrators are concerned about rising numbers of patients who leave without being seen, their primary strategy is to develop long-term solutions in collaboration with primary care and urgent care centers to reduce inflow. For planned admissions, hospitals such as Cases J, M, and U centrally monitor scheduled surgical inflows through their command centers. In the days leading up to service, they may proactively reduce the number of procedures to prevent overcrowding or operating room congestion. This is particularly evident in Case U, where an internally developed algorithm calculates length of stay (LoS) profiles for surgical patients, enabling better anticipation of inpatient congestion.

"We have a tool that we call the surgical smart scheduling tool that we built internally. So as those patients are scheduled, their projected length of stay is calculated and addressed in this tool and allows us to see how we're doing with our surgical census with respect to what's on the schedule and whether or not we need to adjust, whether we should hold on adding more cases, on a certain day, because we look like we're going to exceed our bed footprint." - [Manager peri-op, Case U]

5.3 Internal

Most decision-making related to internal hospital operations occurs at the local level and is detailed, typically made on a patient-by-patient basis. Physicians, nurses, and other healthcare professionals determine which patients to prioritize for examinations, treatments, and progression along their care pathways. Some decisions, however, apply to multiple patients within a unit and involve resource reallocation or reprioritization based on current demand. These decisions are typically made by senior physicians, charge nurses, assistant chief nurse officers, or local flow leaders. Centralized influence varies across hospitals. In Cases A and K, central efforts focus on encouraging units to begin daily ward rounds earlier and in a coordinated sequence, aiming to improve both clinical outcomes and flow efficiency. In contrast, Case M employs a discharge prediction algorithm that identifies the five patients closest to discharge. This list is distributed centrally and used as a starting point for ward round discussions, with follow-up oversight to ensure progression.

"This whole thing kicks off with data that comes out of the discharge prediction tool sending an automatically generated email including a list of five patients that the algorithm is predicting are closest to discharge. The intent here is really just for this to be a starting point for discussion and review and to initially provide a set of patients that we can all agree are the ones that we should focus on to help with patient progression as well as those that are approaching discharge, that have barriers." – [Manager peri-op – case M]

Other central decisions involve identifying patients who have deviated from their planned care trajectories, especially when corrective action exceeds the scope of the local unit. However, many hospitals struggle to detect such deviations due to the lack of integrated systems capable of highlighting delays amid high activity volumes. Case U addresses this challenge by developing structured patient pathways with defined milestones, enabling both local and central alerts when patients fall behind schedule. In some pathways, clinical expeditors are notified or intervene directly to escalate and prioritize flagged patients. Similarly, Case A uses a patient planning and progression system integrated with the EHR to visualize required activities for meeting discharge targets. Unlike hospitals with dedicated expeditors, Case A relies on ward-based flow coordinators to escalate delays to their managers. In the surgical setting, most decisions are made at the detailed level, focusing on advancing individual cases throughout the day. Surgeons, anesthesiologists, and nurse managers continuously update the OR schedule in the days leading up to surgery and on the day of service. While autonomy in adjusting schedules is valued, staff report significant challenges due to interdependencies and manual coordination.

"We identify cases in five levels. Level one is a case that should be done within 30 minutes, level two in two hours, three in six hours, four in 12, and five in 24. I had a level one waiting. So one got done, and another case was supposed to immediately follow it. I had to bump that case out so that I could pull the level one in…patients go through a lot of changes when they have elective surgeries scheduled and we take every opportunity to move cases around so we can do them on time or earlier. However, our biggest challenge is that we are many times delayed because we are waiting for instrument sets. But, if I had a better and more predictive tool to design a more predictable schedule then we should know better how to plan our cases. It just seems like we're always throwing a curveball." – [OR charge nurse – Case J]

Central decision-making becomes critical when barriers affect multiple departments, requiring urgent resolution. In Cases M, J, and U, structured escalation protocols notify clinical expeditors or responsible managers when intervention is needed. All hospitals estimate expected admissions for the current and coming days, integrating these estimates with aggregated discharge forecasts to assess overall demand-capacity balance. Combined with staffing data, these estimates allow leadership to evaluate and communicate the "state of the house." Based on this assessment, central decision-makers—such as command center managers or hospital-wide coordinators—may implement overcapacity measures (e.g., exceeding standard ward limits) or reduce available beds. Centralized staffing decisions are also crucial, as leadership allocates nurses from staffing pools to ensure optimal resource distribution. This coordination helps prevent performance improvements in one area from negatively impacting others.

"I'm trying to let everybody know that we need to start thinking about using systems engineering as our management approach. It means we need to really believe in data and analytics. We need to really think about the role of optimization, and using predictive analytics in our planning and in our operations. I think in terms of system engineering as an approach, capacity management as a function, command center as a tool… If cardiology is expanding their footprint in the community with staffing or buying more clinics, they'll let us know because they're going to need more downstream inpatient beds. Or if we acquire or create a partnership with another hospital we're once again informed because then we may have to help make plans on how to be able to accept those patients. Capacity management must be approached through systems engineering - [Manager office of capacity – Case J]

5.4 Transfer

Decisions regarding patient transfers between hospital settings are made at both local and central levels, but almost exclusively on a patient-by-patient basis. Local representatives—typically ward coordinators or charge nurses—initiate and execute transfers, while central bed coordinators determine the transfer destination, often in collaboration with local staff. Although transfer decisions are individualized, most follow pre-established placement agreements. Across all hospitals, the process begins with a transfer request, after which coordinators identify suitable placements. While placements are not final and wards may object, the degree of flexibility varies. In Hospitals M, J, and U, reversing a placement decision requires substantial justification. If strong arguments are not presented promptly, the issue is escalated to senior leadership for resolution.

"Many times the individual unit leadership and charge nurses are focused on their unit and do not understand why we systemwide may be making different decisions. Our goal is not to put anyone in a dangerous position but sometimes we have to do things outside of their normal so the entire system can benefit. Our team struggles because sometimes they feel like they have to justify every single decision which gets difficult when placing 400 patients a day. We don't really have the time to explain the nuance that goes behind every single decision. However, decisions are very seldom questioned and as long as a bed is ready the placement goes quickly." [Bed coordination manager – Case U]

In Hospital A, objections may take longer to process, but coordinators emphasize the authority of their central role, and trust in centrally managed placements has grown over time. In cases of significant disagreement, patients may remain in the inpatient emergency ward for one to two days to allow for a more thorough evaluation of optimal placement. In Hospital K, transfers are generally expedited, but ward physicians have extended periods during which they can object without triggering escalation. This often results in prolonged ED stays, with patients waiting several hours before a final placement decision is reached.

"The idea is that our bed management system should show available beds. But it's not quite accurate. So this patient might not even be here at all, they might be on their way in. Coming tomorrow. Coming today. Coming this evening. I have no idea where the patient is. On top of the challenge of identifying available beds we may end up in the middle between strong positions, and we only try to facilitate a transfer…It's an interesting thing when

talking about flows. It feels a bit like the more people who are involved, the longer it takes, and it also becomes harder to make it flow smoothly." - [Inpatient bed coordinator – Case K]

5.5 Discharge

Decisions regarding patient discharge are primarily made at the local, frontline level, on a case-by-case basis. Attending physicians, in collaboration with nurses and case managers, assess daily which patients are ready for discharge. This process includes issuing formal discharge orders, confirming post-discharge destinations, arranging transportation or family pickup, and preparing documentation and medications. A key decision point emphasized across all hospitals is the prioritization of discharge-ready patients during morning ward rounds. Increasingly, hospitals recognize that—after addressing the most acutely ill—patients nearing discharge should be prioritized to maintain flow and reduce crowding.

In the ED, discharge decisions (e.g., to home, community care, or outpatient follow-up) are made by attending physicians. Hospital M is developing a system that allows ED staff to independently schedule ambulatory follow-ups, whereas other hospitals still require confirmation from receiving clinics. At the central level, during periods of overcrowding or capacity crises, all hospitals implement interventions to expedite discharges. Typically, assistant chief nursing officers collaborate with ward charge nurses to identify opportunities for increasing patient outflow.

"So we have triggers for when to try to expedite discharges. I think it's when we have 45 boarders in the ED. Then we have to start to use our auxiliary spaces better. I then got to make sure my directors are using that space more efficiently and getting patients up and progressing their discharges. So right now we have 58 ED boarders. That means 58 patients that are just sitting in the emergency. So, I asked them, are there barriers or anything that I need to do to try to open up space for beds, because sometimes we have patients in beds that have been there for months. What's the break? What's the reason? So I will contact them and ask what can we do to make this move faster? And then sometimes it may just be prioritizing the patients. So having a conversation of what patients really need to be moved up the list. And then it's also a conversation with the doctor sometimes to say, OK, you said this patient needs a MRI or needs a procedure, can that be done as an outpatient?" – [Assistant chief nurse officer – Case M]

All hospitals except Case K emphasize the importance of prompt escalation of discharge issues by ward nurses. In Hospital A, nurses are expected to coordinate with other departments to prioritize discharges before escalating to leadership. A unique feature in Case A is that ward nurses liaise directly with community care facilities to encourage discharges from nursing homes, thereby freeing up hospital capacity. In contrast, Hospitals J, M, and U escalate discharge concerns directly to the command center, where senior leadership may intervene. Additionally, Hospitals U and J highlight the proactive role of clinical expeditors, who independently identify and act on discharge barriers.

"We can identify the actual patients who are experiencing those barriers, click on it in the moment and see that this person has an anticipated discharge date of today and is waiting for a lab, and that way Lab can go and prioritize those patients over anyone else and send the phlebotomists to those areas to expedite those patients to meet the anticipated discharge date" – [Manager command center, Case U]

5.6 Analysis and case comparison

Across all cases, decision-making on hospital-wide patient flow exhibits a consistent tendency toward local, detailed decisions, particularly in entry, transfer, and discharge processes. This reflects the immediacy and clinical specificity required in patient-by-patient prioritization, triage, treatment progression, and discharge planning. However, the relative weight of central involvement, and the balance between aggregated and detailed decision-making, differs both by flow aspect and across hospitals. Entry decisions are the most striking example of this duality. While day-to-day admissions and triage are firmly rooted in local, detailed clinical decision-making, all hospitals demonstrate a high reliance on central interventions during periods of overcrowding (e.g., redirecting ambulances, reducing elective admissions, postponing procedures). Figure 3 confirms that entry is the domain with the strongest proportion of central decisions, though the degree varies across cases (Cases U, M, and J show more centrally aggregated planning via algorithmic tools, while Cases K and A rely more on reactive crisis interventions).

For internal flow, the dominance of locally detailed decisions is evident across all hospitals, reflecting the highly individualized nature of care progression within wards and operating rooms. Nevertheless, central oversight grows in importance where systems are in place to monitor aggregated patient progression (e.g., command centers in Cases M, J, and U; EHR-based tracking in Case A). Hospitals differ in whether they primarily strengthen local coordination (e.g., decentralized ward-based flow leaders) or rely on central monitoring and

escalation (e.g., clinical expeditors). Figure 3 reflects this balance, showing a moderate but consistent presence of centrally aggregated decisions alongside the dominant locally detailed ones.

Transfers are executed at the patient-level detailed stage, but flow processes are mediated centrally. Here, local units initiate requests, but central coordinators decide placement, often in negotiation with local staff. Transfer decisions are also overwhelmingly detailed, with aggregated decision-making nearly absent. Case variation lies in the rigidity of the central authority. Cases M, J, and U enforce stricter adherence to central placement, whereas Cases A and K allow more local objections, leading to slower transfers and occasional bottlenecks. Thus, while transfer appears highly standardized in form, its efficiency depends on how strongly central mandates are enforced.

Finally, discharge remains largely a locally detailed process across all hospitals, with central interventions reserved for moments of crisis. Figure 3 illustrates this by showing consistently high proportions of locally detailed decisions, with some cases (J, M, U) involving central oversight through command centers or clinical expeditors. In contrast, Case A takes a more locally driven approach, with ward nurses directly liaising with community care. Thus, while discharge decision-making structures are broadly similar, the escalation routes and degree of central involvement vary across hospitals.

Taken together, the cross-case comparison highlights that entry and transfer are the flow themes most shaped by central authority, though in different ways — entry through centrally aggregated capacity-control decisions and transfer through centrally mediated patient-specific placement decisions. Internal and discharge decisions remain predominantly local and detailed, but cases diverge in how central oversight supplements frontline coordination. Hospitals with advanced digital tools or dedicated flow roles (Cases M, U, J) display a higher proportion of central or aggregated decision-making, whereas others (Cases A, K) rely more on localized and manual coordination, sometimes at the cost of efficiency. This layered pattern suggests that efficient hospital-wide patient flow requires a dynamic balance: maintaining detailed local decision-making for patient care while embedding sufficient central oversight to anticipate capacity constraints, coordinate across units, and enforce timely escalations.

6. Discussion

This study investigates how hospital-wide patient flow is operationalized in practice, with a particular focus on the allocation of decision-making authority. Our findings support the view that hospitals require fundamentally different approaches to operational decision-making compared to traditional manufacturing industries (Katic et al., 2021, Litvak and Bisognano, 2011). While centralized planning and control are often effective in manufacturing settings, hospitals are shaped by professional autonomy, fluctuating demand, and complex interdependencies (Glouberman and Mintzberg, 2001, Braithwaite et al., 2017). Despite the growing interest in centralized decision-making and coordination mechanisms, our evidence shows that hospitals remain highly decentralized organizations, a feature consistent with prior accounts of fragmented structures and competing departmental logics (Glouberman and Mintzberg, 2001, Kreindler, 2017). Local autonomy and distributed decision-making authority are critical for maintaining organizational responsiveness, delivering high-quality care, and ensuring patient safety (Braithwaite et al., 2017). At the same time, our cases echo Åhlin et al. (2023) in showing that insufficient hospital-wide coordination of patient flow hampers efficiency and diminishes system responsiveness.

Our findings illustrate how healthcare organizations design decision-making structures and allocate authority to enable continuous, responsive operational adjustments. Unlike manufacturing industries, where decisions typically follow a predictable hierarchy with centrally developed plans executed locally and escalations occurring only during disruptions, hospital operations demand constant rebalancing of resources and reprioritization of patients. This resonates with research by Devaraj et al. (2013) and Gualandi et al. (2019), who argue that effective patient flow requires cross-departmental alignment and system-level coordination beyond the scope of any single unit. Figure 4 presents our framework for operational decision-making, a refinement of the two-by-two matrix introduced in Figure 1. It highlights that the traditional dichotomy of planning (centrally - aggregated decisions) and control (locally detailed decisions) is insufficient in hospitals and must be complemented by two additional modes: rebalancing (locally aggregated decisions) and reprioritization (centrally detailed decisions). These dynamics reflect the inherently reactive nature of hospital operations. Patient arrivals are unpredictable, conditions evolve rapidly, and multimorbidity increases the complexity of care coordination. This aligns with prior work emphasizing the need for real-time adaptability in healthcare systems (Litvak and Bisognano, 2011, Lovett et al., 2016). Consequently, even well-structured care plans must be frequently revised in light of changing patient needs, system-wide pressures, resource constraints, and treatment reassessments. Local staff continuously reprioritize care and escalate issues when progression stalls, while central expeditors and coordinators proactively intervene to maintain system-wide flow.

Importantly, the conditions under which hospitals operate have shifted. Historically, relatively stable patient flow and greater slack capacity allowed frontline professionals to manage variability within established routines (Plsek and Greenhalgh, 2001). Today, however, rising volumes, shorter lengths of stay, and efficiency-

driven reductions in buffers have amplified operational pressures (Plsek and Greenhalgh, 2001, OECD, 2024, WHO, 2024). These changes simultaneously expand the scope of locally aggregated decisions, where frontline managers must balance workloads to safeguard patient progression, and intensify the need for centrally detailed decisions, where hospital-wide oversight ensures flow continuity across increasingly interdependent care pathways. These findings are consistent with recent research on the growing interdependencies in healthcare delivery and the challenges of fragmented responsibility (Dobrzykowski and Tarafdar, 2015, Gualandi et al., 2019, Johnson et al., 2020). The reasoning underlying these findings is encapsulated in the following proposition.

Proposition 1. *In hospitals, rising patient complexity and shrinking operational margins necessitate both locally aggregated rebalancing and centrally detailed reprioritization decisions to sustain patient flow progression.*

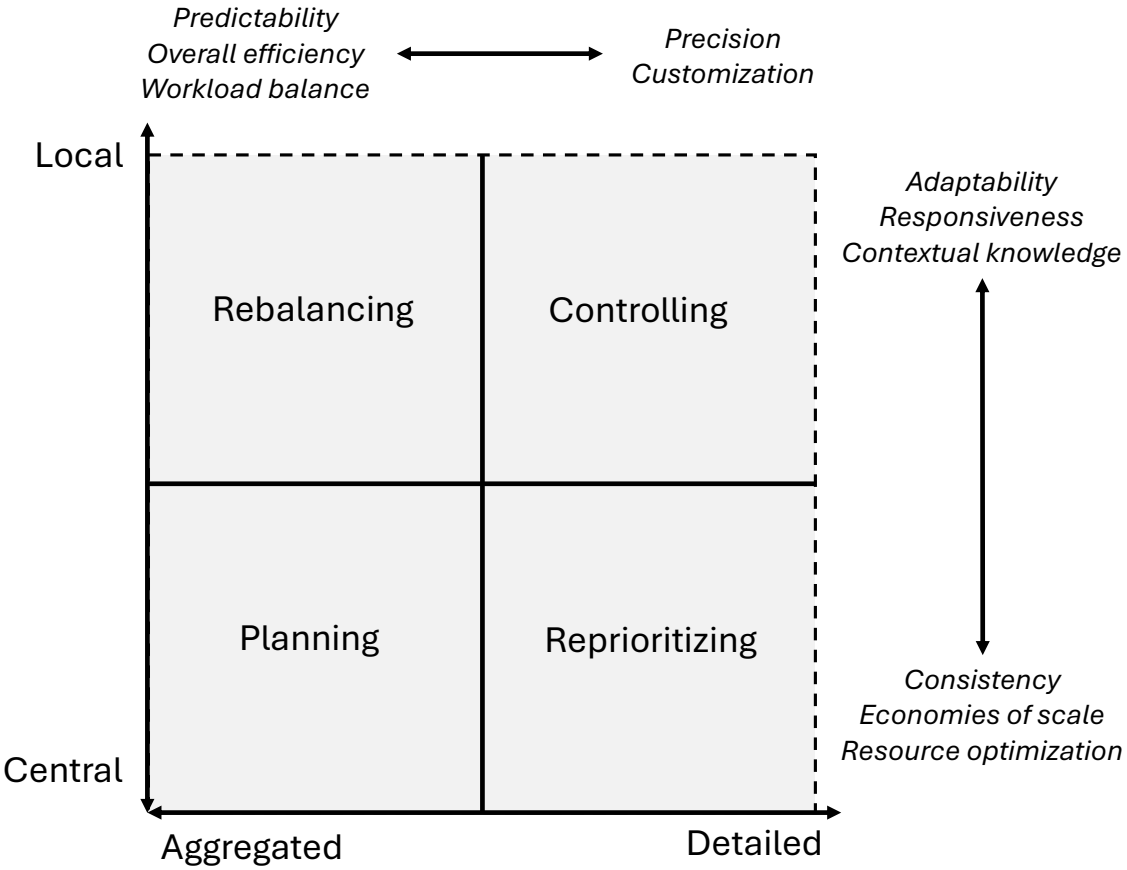


Figure 4: A framework for operational decision-making

Our within-case analysis (Table 2) highlights that all five hospitals, though to varying extents, recognize the need to manage patient flow from a hospital-wide perspective. Each has established structures, whether designated individuals or physical command centers, to monitor daily flow, anticipate bottlenecks, and initiate preventive measures before capacity limits are breached. The role of these structures, however, differs. Command centers emphasize direct, real-time management of patient flow, whereas hospitals without such centers focus more on raising awareness and disseminating information across the organization. While locally detailed decision-making remains indispensable for responding to immediate patient needs, it is insufficient on its own (Franklin et al., 2022). Individual clinics and units cannot plan effectively in isolation, given their interdependencies within the broader hospital system.

Conflicting local priorities often require central intervention to resolve misalignments and direct attention to the most pressing bottlenecks (Grosman-Rimon et al., 2023, Orhan and Kurutkan, 2025). Central decision-makers thus take on the critical task of prioritizing individual cases and reallocating resources from a system-wide perspective, responsibilities that cannot be met solely through decentralized action. This observation resonates with Johnston et al. (2019), who show how local autonomy in scheduling can create system-wide inefficiencies, reinforcing the need for mechanisms that align professional discretion with hospital-wide priorities. Over time, this has led hospitals that previously relied heavily on local autonomy to progressively centralize key aspects of flow management. Centrally aggregated decision-making enables oversight of patient transfers, ensuring that placement reflects not only clinical needs but also demand and capacity across interconnected units.

These coordination mechanisms provide the system-level visibility required to balance workloads, mitigate bottlenecks, and sustain hospital-wide flow under growing operational complexity. We summarize this in the next proposition.

Proposition 2. *As hospital operations grow more complex, centrally aggregated decision-making becomes increasingly necessary to coordinate interdependencies, resolve competing priorities, and maintain patient flow across the organization.*

A strong reliance on locally detailed decision-making is particularly evident in admissions, transfers, and discharges, where frontline professionals make case-by-case judgments about patient progression. Central actors typically intervene reactively, providing guidance when local capacity limits are reached or emerging bottlenecks demand broader coordination. While transfer approvals are centrally coordinated, the initial demand for transfers remains the prerogative of local units. Centrally aggregated decision-making thus plays a complementary role, focused on systemic oversight and capacity management. By synthesizing information on demand pressures and resource availability, central management can balance workloads across the hospital, allocate flexible resources dynamically, and identify when escalating conditions require activating crisis protocols. Beyond immediate operations, centralized coordination also encourages department leaders to adopt a hospital-wide perspective, facilitating collaboration across units to address challenges that no single department can resolve alone. Importantly, however, centralization in healthcare does not equate to hierarchical control. Hospitals, like other professionalized organizations such as universities or law firms, are governed by professional autonomy, peer recognition, and domain expertise rather than command-and-control authority (Glouberman and Mintzberg, 2001).

Effective centralization, therefore, depends on relational governance, where influence is exercised through credibility, trust, and responsiveness rather than directives. This is consistent with Frangeskou et al. (2020), who emphasized the negotiated nature of flow standardization, and with Lan et al. (2022), who highlighted how decisions ultimately reside with physicians even in the presence of structural coordination mechanisms. Command center leaders increasingly assume an advisory role, using data-driven insights to support decision-making while respecting the autonomy of frontline professionals. In this trust-based model, central actors act as facilitators rather than enforcers, aligning managerial coordination with the professional norms that structure hospital work. These considerations lead to our final proposition:

Proposition 3. *In hospitals, decision-making authority is predominantly locally allocated, and centralization needs to be carefully introduced, with central management assuming a trust-based advisory role by providing data-driven guidance and recommendations.*

7. Contributions and limitations

This study makes several contributions to the operations planning and control literature. First, it extends existing theories by demonstrating how hospitals rely on a fundamentally different mix of decision-making logics compared to traditional industries. Whereas manufacturing typically separates centrally aggregated and locally detailed decisions, this study shows that hospitals must continuously combine locally aggregated and centrally detailed decision-making to maintain responsiveness in the face of dynamic and uncertain patient demand.

Second, the study advances understanding of how decision-making authority is allocated in complex service systems. By tracing the interaction between decentralized frontline autonomy and emerging centralized coordination structures, it illustrates how centralization in hospitals is not about command-and-control but about advisory, trust-based facilitation. This reconceptualization of centralization contributes to the literature on relational governance and distributed decision-making in operations management.

Third, the study contributes to the growing stream of research on healthcare operations by empirically documenting the organizational shift toward hospital-wide flow coordination. It highlights the conditions under which central intervention becomes necessary, the mechanisms hospitals use to balance system-wide patient progression, and the potential role of predictive analytics and information systems in enabling more proactive management.

Our research also offers several managerial implications. First, managers should recognize that effective hospital-wide patient flow requires both strong frontline autonomy and selective central coordination. Local units must retain authority for case-level decisions to remain responsive to rapidly changing patient needs, but hospital leadership should complement this with centralized structures (e.g., command centers) that monitor capacity, identify bottlenecks, and provide data-driven guidance. Importantly, this central role should be facilitative rather than directive, supporting trust and collaboration across units rather than undermining professional autonomy.

Second, the study highlights the limits of purely reactive, locally driven decision-making in highly interdependent hospital systems. Managers can improve operational predictability by adopting tools such as predictive analytics and hospital-wide ERP systems to support proactive rebalancing of resources. Such

investments enable leaders to move from ad hoc coordination toward more systematic, forward-looking patient flow management, ultimately enhancing both efficiency and patient safety.

This study is subject to several limitations. First, all data, including interviews, observations, and archival material, were collected by a single researcher, who also conducted all physical site visits to the participating hospitals. This may have constrained the richness and diversity of the data, as the involvement of multiple researchers could have introduced a wider range of perspectives and interpretations. Second, there are limitations related to the consistency of data collection across the different hospital sites. Despite efforts to standardize the structure of each site visit, inherent contextual differences between hospitals meant that the visits varied inevitably. These variations may have influenced the nature and depth of the data gathered at each location. Additionally, the absence of an on-site pilot study may have affected the overall quality and refinement of the data collection process. Another important limitation concerns the generalizability of the findings. The study is based on only five cases in Western healthcare systems, which limits its broader applicability. However, the in-depth nature of each case study required considerable time and effort, making wider inclusion of cases unfeasible within the scope of this research.

Several promising avenues for future research emerged during the course of this study. First, there is a need to continue investigating the rise of centralization and the implementation of command centers or coordination hubs. Future research could explore the optimal balance between local autonomy and centralized decision-making in healthcare systems. Second, the implementation of software that dynamically updates patient care trajectories as they deviate from their initially planned pathways presents a compelling area for exploration. Understanding the impact of such systems, particularly how a shift from reactive to proactive care affects patients, healthcare professionals, and patient throughput, could yield valuable insights. Third, prior research has emphasized that improving hospital-wide patient flow depends on cultivating a collective focus and mindset among healthcare professionals. Further research is needed to examine how such a mindset can be developed and sustained, and what specific role centralized capacity coordination centers play in fostering this organizational transformation.

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Appendix A

Interview Guide on the

Operationalization of Hospital-Wide Patient Flows

1.	Describe what you do in your professional role at the hospital?
2.	Describe the role of the organizational unit you are a part of?
3.	Please, take me through the day-to-day activites at your unit from Monday morning to Sunday afternoon?
4.	How are your, and your units work, associated with the patient flow throughout the hospital?
5.	What information do you need, or work with, in order for you to take decisions and give recommendations to the hospital concerning the hospital-wide patient flow?
6.	What competencies do you need at your unit to efficiently execute your activities?
7.	What is the general outcome or consequence across the hospital of the decisons taken, or recommendations given, by your unit concerning the hospital-wide patient flow?
8.	What is efficient hospital-wide patient flow to you?
9.	What is your view on how your hospital is working today to enable an efficient hospital-wide patient flow?
11.	What have you, your unit, and your hospital done to enable the present structure and procedures to support the patient flow?
12.	What would you like to improve or change in order for the hospital-wide patient flow to improve further?

Appendix B – Decision-making categorizing

Case A

Setting	Decision (recommendation)	Barrier	Local/ Central	Detailed/ Aggregated
Ward	Bed is ready for next patient	Discharge	Local	Detailed
Ward	Clean bed/room after last patient	Discharge	Local	Detailed
Ward	Have patient leave bed/hospital	Discharge	Local	Detailed
Ward	Order transportation out for patient	Discharge	Local	Detailed
Ward	Destination after discharge	Discharge	Local	Detailed
Ward	Order patient discharge med.	Discharge	Local	Detailed
Ward	Prepare patient documentation	Internal	Local	Detailed
Ward	Give patient discharge order	Discharge	Local	Detailed
Ward	Patient health status	Internal	Local	Detailed
Ward	Order test/examination for patient	Internal	Local	Detailed
Ward	Estimate patients expected day of discharge	Discharge	Local	Aggregated
Ward	Order internal patient transport	Discharge	Local	Detailed
Ward	Initiate and coordinate ward round	Internal	Local	Aggregated
Ward	Call radiology to prioritize discharge-ready patient	Discharge	Local	Detailed
Ward	Push for earlier discharges to unload ED	Discharge	Local	Aggregated
Ward	Contact after care for future discharge	Discharge	Local	Detailed
Ward	Decision to transfer patient to home care	Discharge	Local	Detailed
Ward	Decide prioritization of blood sample analysis	Internal	Local	Detailed
Ward	Push community to discharge to enable space	Discharge	Local	Aggregated
Ward	Accept/reject patient placement	Transfer	Local	Detailed
Ward	Patient complexity and bed occupancy	Internal	Local	Aggregated
Ward	Allocate available staff	Internal	Local	Aggregated

Setting	Decision (recommendation)	Barrier	Local/ Central	Detailed/ Aggregated
Central	Patient bed assignment	Transfer	Central	Detailed
Central	Internal transfer of patient	Transfer	Central	Detailed
Central	Rebalance/prioritize ICU patients	Transfer	Central	Aggregated
Central	State of house (transfers, ED situation, help needed)	Internal	Central	Aggregated
Central	External transfer of patients	Entry	Central	Detailed
Central	Open/closed beds across hospital	Internal	Central	Aggregated
Central	Deciding capacity level color of the hospital	Internal	Central	Aggregated
Central	Deciding overcapacity at wards (fixed rates)	Internal	Central	Aggregated
Central	Open overcrowding beds in the ED	Entry	Central	Aggregated
Central	Extra overcrowding conference	Internal	Central	Aggregated
Central	Reduce number of available ward beds	Internal	Central	Aggregated
Central	Available ordinary staff capacity	Internal	Central	Aggregated
Central	Placement of floating staff	Internal	Central	Aggregated

Setting	Decision (recommendation)	Barrier	Local/ Central	Detailed/ Aggregated
OR	Decide daily emergent case acuity	Internal	Local	Detailed
OR	Decide if anaestesiological assessments are correct	Internal	Local	Detailed
OR	DoS allocation of staff/skills to OR rooms	Internal	Local	Aggregated
OR	Decision to change or move DoS OR cases	Internal	Local	Detailed
OR	Decision to add short list case	Entry	Local	Detailed
OR	Decision in OR before surgery on set-up & plan	Internal	Local	Detailed
OR	Decison to start surgery	Internal	Local	Detailed
OR	Decision to call down patient from ward	Transfer	Local	Detailed
OR	Decide OR program at OR conference	Internal	Local	Aggregated
OR	Decision to prioritize cleaning of OR	Internal	Local	Detailed
OR	Allocation of OR tools	Internal	Local	Aggregated
OR	Decision to add case to OR program <DoS	Entry	Local	Detailed

Setting	Decision (recommendation)	Barrier	Local/ Central	Detailed/ Aggregated
ED	Triaging and prioritizing of patients	Entry	Local	Detailed
ED	Deciding on split flow for easier patients	Internal	Local	Detailed
ED	Decision to appoint team to patient	Internal	Local	Detailed
ED	Entering patient in Klinisk Logistikk (registering)	Internal	Local	Detailed
ED	Determine patient medical status	Internal	Local	Detailed
ED	Decision to order set of tests	Internal	Local	Detailed
ED	Entering patient activities in Klinisk Logistikk	Internal	Local	Detailed
ED	Deciding on admission to hospital	Entry	Local	Detailed
ED	Deciding patients clinic destination	Transfer	Local	Detailed
ED	ED radiology conference to prioritize patients	Internal	Local	Aggregated
ED	Calling down clinic doctor(s) to see/care for patient	Transfer	Local	Detailed
ED	Decisions on situational prioritizations	Internal	Local	Aggregated
ED	Decisions on use of auxilliary beds	Internal	Local	Aggregated
ED	Decide EDD for patient	Discharge	Local	Detailed
ED	Admit patient to outpatient clinic appointment	Discharge	Local	Detailed
ED	Discharge patient to home care	Discharge	Local	Detailed
ED	Discharge person off system	Discharge	Local	Detailed
ED	Confirm/allocate available staff	Internal	Local	Aggregated
ED	Determine bed occupancy	Internal	Local	Aggregated

Case K

Setting	Decision (recommendation)	Barrier	Local/ central	Detailed/ aggregated
Floor	Have patient leave bed/hospital	Discharge	Local	Detailed
Floor	Clean bed/room after last patient	Discharge	Local	Detailed
Floor	Have patient leave bed/hospital	Discharge	Local	Detailed
Floor	Order transportation out for patient	Discharge	Local	Detailed
Floor	Confirm destination after discharge	Discharge	Local	Detailed
Floor	Order patient discharge med.	Discharge	Local	Detailed
Floor	Prepare patient documentation	Discharge	Local	Detailed
Floor	Give patient discharge order	Discharge	Local	Detailed
Floor	Decide patient health status	Internal	Local	Detailed
Floor	Order patient test/examination	Internal	Local	Detailed
Floor	Decide todays discharge estimation	Discharge	Local	Aggregated
Floor	Initiate daily ward/discharge round	Internal	Local	Aggregated
Floor	Patient complexity and bed occupancy	Internal	Local	Aggregated
Floor	Escalate progression problems to leadership	Internal	Local	Detailed
Floor	Transfer of patient (upgrade/downgrade)	Transfer	Local	Detailed
Floor	Accept/reject patient placement	Entry	Local	Detailed
Floor	Decide to go and get ED/OR patient	Transfer	Local	Detailed
Floor	Confirm/allocate available staff	Internal	Local	Aggregated

Setting	Decision (recommendation)	Barrier	Local/ central	Detailed/ aggregated
Hospital	Patient bed assignment	Transfer	Central	Detailed
Hospital	Internal patient transfer	Transfer	Central	Detailed
Hospital	Todays admission/discharge estimations	Entry	Central	Aggregated
Hospital	Decide state of the house	Internal	Central	Aggregated
Hospital	Hospital transfer(s) of patients	Entry	Central	Detailed
Hospital	Entering over capacity mode	Internal	Central	Aggregated
Hospital	Exceed floor capacity for ED patients	Entry	Central	Aggregated
Hospital	Floors must accept 2 ED patients (8:00/10:00)	Transfer	Central	Aggregated
Hospital	Acute reduction of available ward beds	Internal	Central	Aggregated
Hospital	Resolving weekly flow problems	Transfer	Central	Detailed
Hospital	Increase patient outflow	Discharge	Central	Aggregated
Hospital	Increase discharges to home care programs	Discharge	Central	Detailed
Hospital	Confirm hospital available staff	Internal	Central	Aggregated
Hospital	Placement of pool nurses	Internal	Central	Aggregated

Setting	Decision (recommendation)	Barrier	Local/ central	Detailed/ aggregated
OR	Move cases/modify schedule DoS	Internal	Local	Detailed
OR	Patient health status before surgery	Internal	Local	Detailed
OR	Confim next week OR Program	Internal	Local	Aggregated
OR	Confirm tomorrow OR DoS schedule	Internal	Local	Aggregated
OR	Allocation of OR staff	Internal	Local	Aggregated
OR	Call down patient to OR	Transfer	Local	Detailed
OR	Confirm patient floor-transfer-ready	Transfer	Local	Detailed
OR	Prioritize cleaning of OR theatre	Internal	Local	Detailed
OR	Decision to start surgery	Internal	Local	Detailed
OR	DoS case prioritization/cancellation	Internal	Local	Detailed
OR	Confirm open theatres	Internal	Local	Aggregated
OR	<DoS Scheduling of OR program	Entry	Local	Detailed
OR	Resource scarcity prioritization meeting	Internal	Local	Detailed
OR	Plan OR week + staffing	Internal	Local	Aggregated
OR	Rescheduling case risking cancellation	Internal	Local	Detailed
OR	Take back OR time	Entry	Local	Aggregated
OR	Escalate problems to leadership	Transfer	Local	Detailed

Setting	Decision (recommendation)	Barrier	Local/ central	Detailed/ aggregated
ED	Acuity level at traige	Entry	Local	Detailed
ED	Appoint team to patient	Entry	Local	Detailed
ED	Determine patient medical status	Internal	Local	Detailed
ED	Order set of tests	Internal	Local	Detailed
ED	Decide for inpatient admission	Entry	Local	Detailed
ED	Direct patient to the OR/ICU	Transfer	Local	Detailed
ED	Initiate direct admission	Transfer	Local	Detailed
ED	Off-system discharge	Discharge	Local	Detailed
ED	Home care discharge	Discharge	Local	Detailed
ED	Discharge to psychiatry	Discharge	Local	Detailed
ED	Move to emergency care bed	Internal	Local	Detailed
ED	Escalation of transfer problem/delay	Transfer	Local	Detailed
ED	Confirming occupancy level at the ED	Entry	Local	Aggregated
ED	Confirm/allocate available staff	Internal	Local	Aggregated

Case U

Setting	Decision (recommendation)	Barrier	Local/ Central	Detailed/ Aggregate
Floor	Have patient leave bed/hospital	Discharge	Local	Detailed
Floor	Order transportation out for patient	Discharge	Local	Detailed
Floor	Destination after discharge	Discharge	Local	Detailed
Floor	Order patient discharge med.	Discharge	Local	Detailed
Floor	Prepare patient documentation	Discharge	Local	Detailed
Floor	Give patient discharge order	Discharge	Local	Detailed
Floor	Patient health status	Internal	Local	Detailed
Floor	Patient finances cleared	Internal	Local	Detailed
Floor	Todays discharge estimation	Discharge	Local	Aggregated
Floor	Future discharge estimation	Discharge	Local	Aggregated
Floor	Order of patients at round	Discharge	Local	Aggregated
Floor	Order patient test/examination	Internal	Local	Detailed
Floor	Escalate patient discharge barrier	Discharge	Local	Detailed
Floor	Internal transfer of patient	Internal	Local	Detailed
Floor	Accept/reject patient placement	Transfer	Local	Detailed
Floor	Decide to bring ED patient	Transfer	Local	Detailed
Floor	Escalate LLOS patient	Discharge	Local	Detailed
Floor	Patient complexity and pressure	Internal	Local	Aggregated
Floor	Allocate available staff	Internal	Local	Aggregated
	Increase patient out-flow	Discharge	Local	Aggregated

Setting	Decision (recommendation)	Barrier	Local/ Central	Detailed/ Aggregate
CC	Patient placement	Transfer	Central	Detailed
CC	Internal transfer of patient	Transfer	Central	Detailed
CC	Todays admission estimation	Entry	Central	Aggregated
CC	State of the house	Internal	Central	Aggregated
CC	Capacity crisis mode	Internal	Central	Aggregated
CC	External patient transfer(s)	Entry	Central	Aggregated
CC	Open/close beds, auxilliary beds	Internal	Central	Aggregated
CC	OR program reduction	Internal	Central	Aggregated
CC	Escalate progression barrier	Discharge	Central	Detailed
CC	Escalate system barrier	Internal	Central	Aggregated
CC	Prioritize discharge-ready patients	Discharge	Central	Aggregated
CSR	Available ordinary staff capacity	Internal	Central	Aggregated
CSR	Placement of floating staff	Internal	Central	Aggregated
CSR	Placement of CSR pool nurses	Internal	Central	Aggregated
Hospital	Initiate ambulance diversion	Entry	Central	Aggregated

Setting	Decision (recommendation)	Barrier	Local/ Central	Detailed/ Aggregate

OR	Determine OR program DoS	Internal	Local	Aggregated
OR	Confirm/allocate DoS OR staff	Internal	Local	Aggregated
	Confirm open OR theatres	Internal	Local	Aggregated
OR	Confirm OR patient health status	Internal	Local	Detailed
OR	Prioritize acute ED- and inpatients	Internal	Local	Detailed
OR	Cancel, add, move case DoS	Internal	Local	Detailed
OR	Move case to ambulatory	Transfer	Local	Detailed
OR	Call down patient to OR	Transfer	Local	Detailed
OR	Prioritize cleaning of OR theatre	Internal	Local	Detailed
OR	Confirm OR schedule until DoS	Internal	Local	Aggregated
OR	Allocation of OR tools	Internal	Local	Aggregated
OR	Take back OR time	Internal	Local	Aggregated

Setting	**Decision (recommendation)**	**Barrier**	**Local/ Central**	**Detailed/ Aggregate**
ED	Acuity screening before triage	Entry	Local	Detailed
ED	Acuity level at traige	Entry	Local	Detailed
ED	Appoint team to patient	Internal	Local	Detailed
ED	Initiate fast track	Internal	Local	Detailed
ED	Odd case process	Internal	Local	Detailed
ED	Determine patient medical status	Internal	Local	Detailed
ED	Order set of tests	Internal	Local	Detailed
ED	Direct patient to the OR/ICU	Entry	Local	Detailed
ED	Direct inpatient admission	Entry	Local	Detailed
ED	Decide for inpatient admission	Entry	Local	Detailed
ED	Confirm/allocate available staff	Internal	Local	Aggregated
ED	Determine available bed capacity	Internal	Local	Aggregated
ED	Off-system discharge	Discharge	Local	Detailed
ED	Home care discharge	Discharge	Local	Detailed
ED	Schedule ambulatory appointment	Discharge	Local	Detailed
ED	Move patient to acute bed	Internal	Local	Detailed
ED	Have hospitalist round at ED	Internal	Local	Detailed

Case J

Setting	Decision (recommendation)	Barrier	Local/ Central	Detailed/ Aggregated
Floor	Have patient leave bed/hospital	Discharge	Local	Detailed
Floor	Order transportation out for patient	Discharge	Local	Detailed
Floor	Destination after discharge	Discharge	Local	Detailed
Floor	Order patient discharge med.	Discharge	Local	Detailed
Floor	Prepare patient documentation	Discharge	Local	Detailed
Floor	Give patient discharge order	**Discharge**	Local	**Detailed**
Floor	Patient health status	**Internal**	Local	**Detailed**
Floor	Patient finances cleared	**Internal**	Local	**Detailed**
Floor	Todays discharge estimation	Discharge	Local	**Aggregated**
Floor	Future discharge estimation	Discharge	Local	Aggregated
Floor	Priorities at mutli-disc. discharge round	Discharge	Local	Aggregated
Floor	Order patient test/examination	Internal	Local	Detailed
Floor	Escalate patient discharge barrier	Discharge	Local	Detailed
Floor	Transfer of patient (upgrade/downgrade)	Transfer	Local	Detailed
Floor	Accept/reject patient placement	Transfer	Local	Detailed
Floor	Decide to go and get ED/OR patient	Transfer	Local	Detailed
Floor	Escalate LLOS patient	Discharge	Local	Detailed
Floor	Patient complexity and bed occupancy	Internal	Local	Aggregated
Floor	Allocate available staff	Internal	Local	Aggregated
Floor	Expediate patient out-flow	Discharge	Local	Aggregated
Floor	Discharge directly from ICU	Discharge	Local	Detailed

Setting	Decision (recommendation)	Barrier	Local/ Central	Detailed/ Aggregated
CM	Patient bed assignment	Transfer	Central	Detailed
CM	Internal transfer of patient	Transfer	Central	Detailed
CM	Rebalance/prioritize ICU patients	Entry	Central	Aggregated
CM	Todays admission estimation	Entry	Central	**Aggregated**
CM	State of the house	Internal	Central	**Aggregated**
CM	Capacity distaster level	Internal	Central	Aggregated
CM	Patient transfer(s)	Entry	Central	Aggregated
CM	OR reduction to elimin. ICU bottlenecks	Internal	Central	Aggregated
CM	Escalate progression barrier	Discharge	Central	Detailed
CM	Escalate system barrier	Internal	Central	Aggregated
CM	Prioritize discharge-ready patients	Discharge	Central	Aggregated
CSR	Available ordinary staff capacity	Internal	Central	Aggregated
CSR	Placement of floating staff	Internal	Central	Aggregated
CSR	Placement of SSU pool nurses	Internal	Central	Aggregated
CM	Initiate ambulance diversion	Entry	Central	Aggregated

Setting	Decision (recommendation)	Barrier	Local/ Central	Detailed/ Aggregated

OR	Determine OR program DoS	Internal	Local	Aggregated
OR	Confirm/allocate DoS OR staff	Internal	Local	Aggregated
OR	Confirm open OR theatres	Internal	Local	Aggregated
OR	Confirm OR patient health status	Internal	Local	Detailed
OR	Prioritize acute ED- and inpatients	Internal	Local	Detailed
OR	Cancel, add, move case (DoS-2d)	Internal	Local	Detailed
OR	Move case to ambulatory	Transfer	Local	Detailed
OR	Call down patient to OR	Transfer	Local	Detailed
OR	Confirm patient floor ready	Internal	Local	Detailed
OR	Prioritize cleaning of OR theatre	Internal	Local	Detailed
OR	Confirm OR schedule until DoS	Internal	Local	Aggregated
OR	Allocation of OR tools	Internal	Local	Aggregated
OR	Ensure clinics fill slots	Internal	Local	Aggregated
OR	Escalate bed need to CM	Internal	Local	Aggregated
CM	Consolidate PACU patients	Internal	Local	Aggregated

Setting	**Decision (recommendation)**	**Barrier**	**Local/ Central**	**Detailed/ Aggregated**
ED	Acuity level at traige	Entry	Local	Detailed
ED	Overrule patient prioritization	Entry	Local	Detailed
ED	Appoint team to patient	Internal	Local	Detailed
ED	Initiate fast track	Internal	Local	Detailed
ED	ED bed patient placement	Internal	Local	Detailed
ED	Determine patient medical status	Internal	Local	Detailed
ED	Order set of tests	Internal	Local	Detailed
ED	Direct patient to the OR/ICU	Entry	Local	Detailed
ED	Initiate direct admission	Entry	Local	Detailed
ED	Decide for inpatient admission	Entry	Local	Detailed
ED	Confirm/allocate available staff	Internal	Local	Aggregated
ED	Determine bed occupancy	Internal	Local	Aggregated
ED	Off-system discharge	Discharge	Local	Detailed
ED	Home care discharge	Discharge	Local	Detailed
ED	Discharge to psychiatry	Discharge	Local	Detailed
ED	Schedule ambulatory appointment	Discharge	Local	Detailed
ED	Have hospitalist round at ED	Internal	Local	Detailed
ED	Prioritize slow moving patient	Internal	Local	Detailed

Case M

Setting	Decision (recommendation)	Barrier	Local/ central	Detailed/ aggregated
Floor	Bed is ready for next patient	Discharge	Local	Detailed
Floor	Clean bed/room after last patient	Discharge	Local	Detailed
Floor	Have patient leave bed/hospital	Discharge	Local	Detailed
Floor	Order transportation out for patient	Discharge	Local	Detailed
Floor	Destination after discharge	Discharge	Local	Detailed
Floor	Order patient discharge med.	Discharge	Local	Detailed
Floor	Prepare patient documentation	Discharge	Local	Detailed
Floor	Give patient discharge order	Discharge	Local	Detailed
Floor	Patient health status	Internal	Local	Detailed
Floor	Patient finances cleared	Internal	Local	Detailed
Floor	Todays discharge estimation	Discharge	Local	Aggregated
Floor	Future discharge estimation	Discharge	Local	Aggregated
Floor	Priorities at mutli-disc. discharge round	Discharge	Local	Aggregated
Floor	Order patient test/examination	Internal	Local	Detailed
Floor	Escalate patient discharge barrier	Discharge	Local	Detailed
Floor	Transfer of patient (upgrade/downgrade)	Transfer	Local	Detailed
Floor	Accept/reject patient placement	Transfer	Local	Detailed
Floor	Decide to go/ get ED/OR patient	Transfer	Local	Detailed
Floor	Escalate LLOS patient	Discharge	Local	Detailed
Floor	Patient complexity and bed occupancy	Internal	Local	Aggregated
Floor	Allocate available staff	Internal	Local	Aggregated
Floor	Expediate patient out-flow	Discharge	Local	Aggregated
Floor	Discharge directly from ICU	Discharge	Local	Detailed

Setting	Decision (recommendation)	Barrier	Local/ central	Detailed/ aggregated
CM	Patient bed assignment	Transfer	Central	Detailed
CM	Internal transfer of patient	Transfer	Central	Detailed
CM	Rebalance/prioritize ICU patients	Internal	Central	Aggregated
CM	Todays admission estimation	Entry	Central	Aggregated
CM	State of the house	Internal	Central	Aggregated
CM	Capacity distaster level	Internal	Central	Aggregated
CM	Patient transfer(s) (direct admits)	Entry	Central	Aggregated
CM	OR schedule decisions in collaboration	Internal	Central	Aggregated
CM	Reduce OR schedule prioritize ED patients	Entry	Central	Aggregated
CM	Escalate denied patient placement	Transfer	Central	Detailed
CM	Decide on progression barrier	Internal	Central	Aggregated
CM	Escalate progression barrier	Internal	Central	Detailed
CM	Relocate beds and staff at capacity disaster	Internal	Central	Aggregated
CM	Escalate system barrier	Internal	Central	Aggregated
CM	Prioritize discharge-ready patients	Discharge	Central	Aggregated
CM	Force floors to take ED patients to decant	Transfer	Central	Aggregated
CSR	Available ordinary staff capacity	Internal	Central	Aggregated
CSR	Placement of floating staff	Internal	Central	Aggregated
CSR	Placement of SSU pool nurses	Internal	Central	Aggregated
CM	Initiate ambulance diversion	Entry	Central	Aggregated

Setting	Decision (recommendation)	Barrier	Local/ central	Detailed/ aggregated
OR	Determine OR program DoS	Internal	Local	Aggregated
OR	Confirm/allocate DoS OR staff	Internal	Local	Aggregated
OR	Confirm open theatres	Internal	Local	Aggregated
OR	Confirm OR patient health status	Internal	Local	Detailed
OR	Prioritize acute ED- and inpatients	Internal	Local	Detailed
OR	Cancel, add, move case DoS	Internal	Local	Detailed
OR	Move case to ambulatory	Transfer	Local	Detailed
OR	Call down patient to OR	Transfer	Local	Detailed
OR	Confirm patient floor-transfer-ready	Transfer	Local	Detailed
OR	Prioritize cleaning of OR theatre	Internal	Local	Detailed
OR	Add case to OR schedule <1 week to DoS	Internal	Local	Aggregated
OR	Add case to OR schedule >1 week to DoS	Internal	Local	Aggregated
OR	Allocation of OR tools	Internal	Local	Aggregated
OR	Ensure clinics fill slots	Entry	Local	Aggregated
OR	Escalate flow barrier to CCC	Discharge	Local	Aggregated

Setting	Decision (recommendation)	Barrier	Local/ central	Detailed/ aggregated
ED	Acuity level at traige	Entry	Local	Detailed
ED	Appoint team to patient	Internal	Local	Detailed
ED	Initiate fast track	Internal	Local	Detailed
ED	ED bed patient placement	Internal	Local	Detailed
ED	Determine patient medical status	Internal	Local	Detailed
ED	Order set of tests	Internal	Local	Detailed
ED	Direct patient to the OR/ICU	Entry	Local	Detailed
ED	Initiate direct admission	Entry	Local	Detailed
ED	Decide for inpatient admission	Entry	Local	Detailed
ED	Confirm/allocate available staff	Internal	Local	Aggregated
ED	Determine bed occupancy	Internal	Local	Aggregated
ED	Off-system discharge	Discharge	Local	Detailed
ED	Home care discharge	Discharge	Local	Detailed
ED	Discharge to psychiatry	Discharge	Local	Detailed
ED	Schedule ambulatory appointment	Discharge	Local	Detailed
ED	Put patient in observation unit	Discharge	Local	Detailed

Paper V

Åhlin, P. Bottom-up perspectives on hospital-wide patient flow – A multi-site qualitative study of solutions to organizational paradoxes. Currently under review at *BMC Health Services Research*

Bottom-up perspectives on hospital-wide patient flow – A multi-site qualitative study of solutions to organizational paradoxes

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Abstract

Background: As healthcare demand outpaces capacity, improving hospital productivity is critical. Prior research suggests hospital-wide patient flow improvements can enhance efficiency but has largely neglected the insights of frontline healthcare professionals without managerial responsibilities. This study explores their perspectives on enabling efficient patient flow across hospitals.

Methods: Semi-structured interviews were conducted with 15 nurses and 15 physicians at six Swedish tertiary and secondary care hospitals. A thematic analysis followed, based on inductive reasoning to identify meaningful subjects and themes.

Results: This study identifies seven paradoxes experienced by frontline healthcare professionals associated with hospitals' efforts to enable efficient hospital-wide patient flow, linked to leadership, organizational design, routines, professional culture, and technology. These tensions intensify under operational stress and often lead to overtime or compromised care. Professionals emphasized the need for more aligned structures, clearer patient flow strategies, and performance metrics that support efficient transitions of patients. They advocated for more centralized coordination, better adherence to standardized routines, and investment in IT tools to improve decision-making. A critical finding is the gap between nurses' understanding of patient flow and patient progression and their limited authority and mandates to progress patients, highlighting the need for stronger nurse-physician collaboration.

Conclusions: Enhancing hospital-wide patient flow requires increased system-level coordination, better aligned hospital structures, and improved operational planning. The solutions proposed by frontline professionals also largely align with previously identified managerial strategies for improved hospital-wide patient flows, suggesting a shared understanding that could be leveraged to drive meaningful change.

Keywords: Healthcare, Efficiency, Productivity, Throughput, Frontline, System-wide, Improvement, Challenges

Background

Healthcare systems worldwide are facing increasing pressure due to rising patient demand (1), chronic staffing shortages (2), and continuously increasing healthcare expenditures as a percentage of national GDP (3), limiting hospitals' ability to provide appropriate care at the right time (4). Previous research has highlighted the importance of improving patient flow to enhance hospital efficiency (5). Studies have shown that focusing more on the movement of patients through hospitals can lead to reduced length of stay (LoS), more efficient discharge processes, and better patient throughput (5-8). Beyond efficiency gains, enhancing patient flow has also been linked to improved medical outcomes, patient safety, and overall satisfaction (9, 10). Several studies also highlight the need to take a hospital-wide view when addressing patient flow improvements, referring to the coordinated movement of patients through various stages of care, from admission to discharge, while ensuring efficiency and quality of service (11-14). However, research on how to enable efficient hospital-wide patient flows has centered on the views of healthcare managers and managerial strategies, with little attention given to the perspectives of frontline healthcare professionals who interact directly with patients throughout their hospital journey. This oversight seems to stem from the complexity of healthcare's organizational structures, entrenched occupational hierarchies, power dynamics, and communication barriers (15). It is also influenced by the traditionally top-down orientation of research in organizational development and operations management (16, 17).

Healthcare professionals, including nurses, physicians, and other clinical staff, play a crucial role in the daily management of patient flow. Their perspectives provide valuable insights into the practical challenges and opportunities for improving patient flow efficiency (14). However, previous research, focusing on managerial interventions, overlooks these frontline views and experiences, which are often central to the success of improvement projects (18-20) and may provide valuable perspectives on how flow strategies should be implemented in practice. Given that hospitals are complex organizations with often competing departmental objectives (17, 21, 22), understanding the enablers and barriers to effective patient flow from a healthcare professional's standpoint is essential for creating sustainable improvements (18, 23). Therefore, this study aims to explore the perspectives of healthcare professionals without managerial responsibilities on how to enable efficient hospital-wide patient flow. Specifically, it examines the factors they identify as barriers and solutions to improving patient flow across departments and along care pathways. By incorporating their insights, this research contributes

to a more comprehensive understanding of hospital-wide patient flow challenges and potential solutions, ultimately supporting the development of more effective and contextually relevant strategies.

Healthcare organizations often function as "job shops," where autonomous departments provide specialized services to address specific medical issues (24, 25). Depending on the severity of their condition and treatment needs, patients referred to a hospital may visit one or several specialized departments. Patient flow is often viewed in terms of process throughput, with the goal of improving efficiency and productivity (5, 7, 26). Effective flow management thus relies on minimizing process delays, with Length of Stay (LoS) serving as a key metric of performance (5, 27). However, many stakeholders within the care pathway prioritize their own departmental efficiency over broader hospital-wide coordination, inadvertently creating bottlenecks (28, 29). One of the most visible and pressing consequences of these inefficiencies is hospital overcrowding, particularly in Emergency Departments (EDs), where delays in inpatient transfers due to a lack of available beds lead to 'blocking' effects. This not only prolongs ED wait times but may result in patients being admitted to inappropriate wards, potentially compromising care quality (4, 5, 9). Overcrowding often stems from hospital occupancy rates exceeding capacity, which extends throughput times, increases LoS, and contributes to staff burnout. Addressing these issues requires not only improving discharge planning and inpatient flow, but also balancing competing pressures within hospitals: increasing efficiency while maintaining individualized, high-quality care. Studies have shown that standardizing routines and streamlining processes can enhance throughput, but may also risk reducing professional discretion or compromising patient-centered care, concerns frequently raised by frontline staff (30, 31). These tensions are particularly visible in fast-paced, high-pressure settings such as Emergency Departments, where staff must constantly balance clinical judgment with organizational demands. Recognizing and grappling with this tension is essential to developing effective and context-sensitive flow strategies.

While previous frameworks have mapped barriers and suggested solutions to efficient hospital-wide patient flows, for instance, Åhlin et al. (32) offer a taxonomy of hospital-wide flow challenges related to entry, transfer, internal processes, discharge, and the management system, see Figure 1. They describe the importance for hospitals to align their organizations; build coordination and transfer structures; ensure physical capacity capabilities; develop standards, checklists, and routines; invest in digital and analytical tools; improve their management of operations; optimize capacity utilization and occupancy rates; and seek external solutions and policy changes. These models have contributed to our understanding of patient flow by systematically categorizing process-related issues and potential interventions. However, such approaches often treat these issues as technical problems to be resolved through better coordination, standardization, planning, or resource allocation.

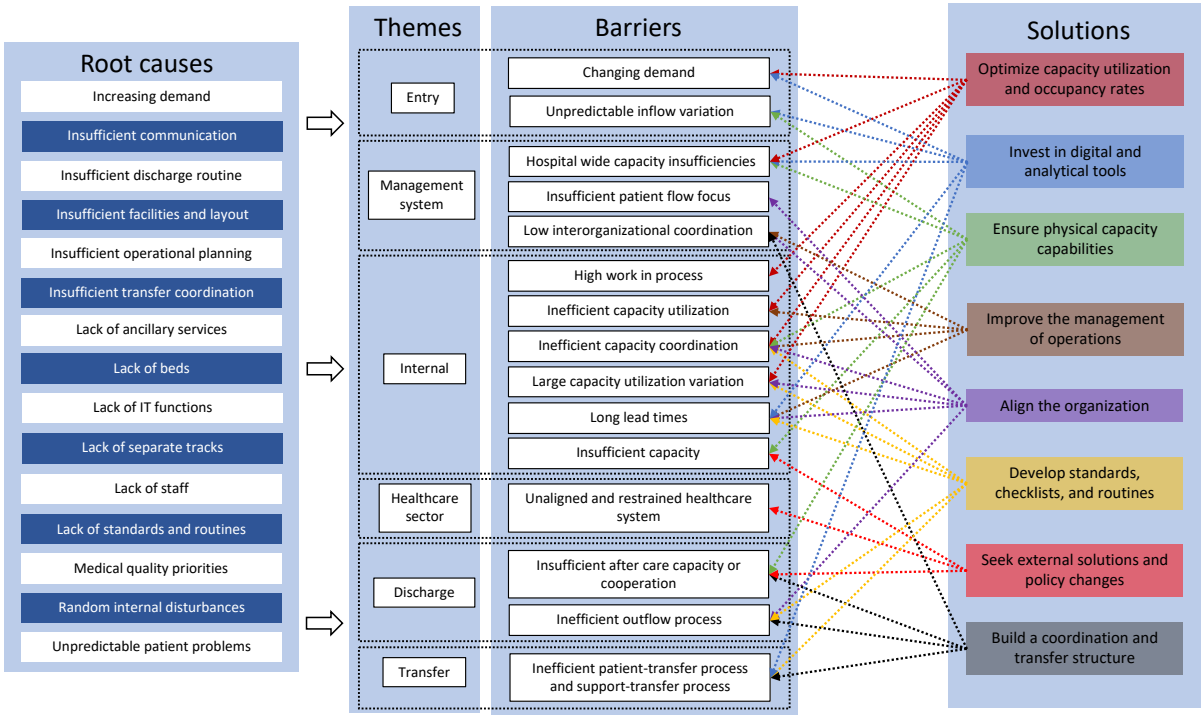

Figure 1: The hospital-wide patient flow improvement framework, Åhlin et al. (13)

Yet, as this study found, frontline healthcare professionals frequently described challenges that were not merely logistical, but deeply contradictory. Participants voiced concerns about the tension between localized efficiency and hospital-wide collaboration, between professional autonomy and standardized protocols, and between short-term patient flow goals and long-term quality of care. These are not simply "barriers" to be removed, but persistent

organizational tensions that resist straightforward solutions. To better understand these dynamics, this study adopts a paradox lens. Drawing on the theory of organizational paradoxes, particularly the framework proposed by Smith and Lewis (33), was used to conceptualize these tensions as "contradictory yet interdependent elements that exist simultaneously and persist over time." From this perspective, the difficulties encountered in improving patient flow are not just implementation gaps but stem from competing demands that are embedded in the structure and logic of healthcare organizations themselves. This theoretical approach allows us to move beyond descriptive accounts of barriers and enablers to uncover how frontline staff navigate the simultaneous pressures of efficiency, quality, autonomy, and coordination. It also highlights why well-intended flow interventions may generate new problems, requiring staff to constantly adapt and reinterpret organizational goals in practice. In doing so, this study offers a more dynamic and grounded understanding of hospital-wide patient flow, informed by the everyday experiences of those most directly involved. By foregrounding paradoxes as a central conceptual lens, this study aims to provide insight into the complex realities of improving care coordination across hospital systems.

Paradox theory

Paradoxes or contradictions, as phenomena, are repeatedly found as leaders address fundamental questions on how to design and develop organisations, establishing boundaries that create distinctions and dichotomies (34). In the process of forming organizations, Smith and Lewis (33) note that "leaders must decide what they are going to do, how they are going to do it, who will be responsible for it, and within what timeframe. By defining their objectives, leaders simultaneously establish what falls outside their scope." This process clarifies strategic goals while also generating tensions, such as global versus local priorities, social versus financial values, loose versus tight coupling, centralization versus decentralization, and flexibility versus control. Paradoxes can be understood as "contradictory yet interdependent elements that exist simultaneously and endure over time" (33). In other words, they represent tensions that emerge within organizations due to competing demands (35). In their influential paper, Smith and Lewis (33) introduce a dynamic equilibrium model of organizing, offering a step toward developing a broader theory of paradoxes, see Figure 2.

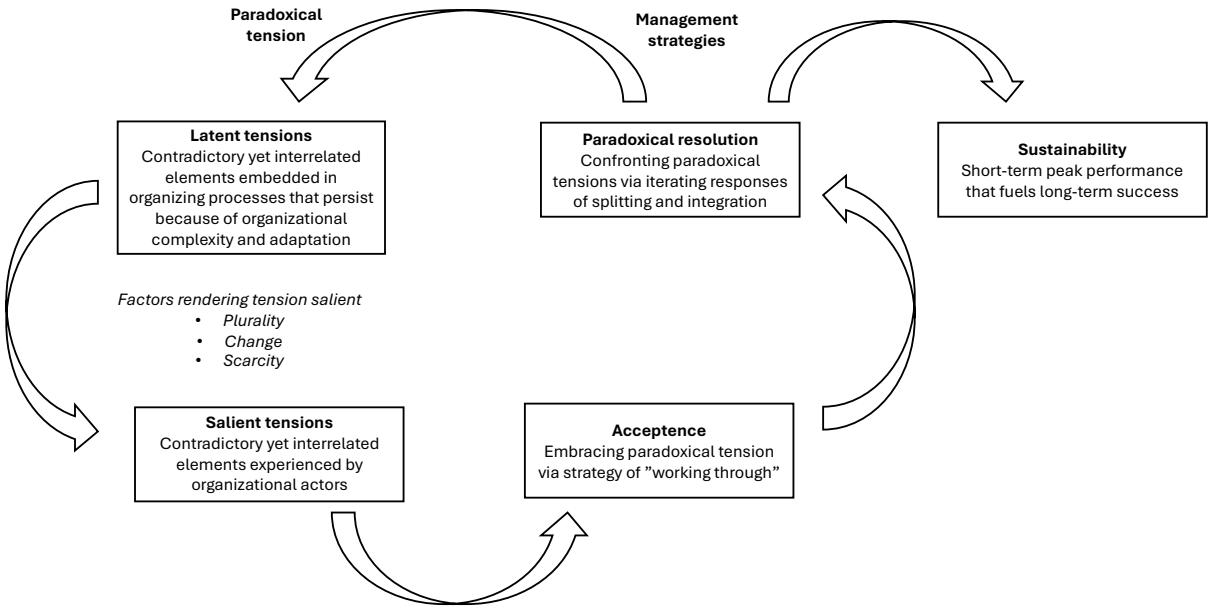

Figure 2: Organizing model on paradoxes adapted from Smith and Lewis (33)

The model underscores some key aspects. *First*, paradoxical tensions within organizations exist both in latent and salient forms. *Second*, responses to these tensions involve cycling through different management approaches. *Third,* the consequences or influences of these management strategies on sustainability. While tensions persist within organizational frameworks, they may remain dormant, unnoticed, or overlooked until external conditions or cognitive efforts (rendering factors) highlight their contradictory and interconnected nature. When latent tensions surface, they become more pronounced, leading organizational members to directly experience their conflicting and inconsistent characteristics. Smith and Lewis (33) argue that rendering factors, specifically plurality, change, and scarcity, transform latent tensions into salient (visible) ones. Plurality refers to the coexistence of multiple perspectives in environments where power is dispersed (36). This diversity amplifies uncertainty, revealing clashing objectives and misaligned processes. Similarly, change introduces fresh opportunities for sensemaking as individuals navigate conflicting short- and long-term priorities (37) alongside competing yet interdependent roles and emotions. Lastly, scarcity pertains to constraints on resources, whether

time, finances, or human capital. As leaders make allocation decisions, these limitations intensify the struggle between competing yet interlinked alternatives (38). Collectively, plurality, change, and scarcity push the boundaries of rational decision-making and strain organizational systems. Consequently, individuals are more likely to fragment interconnected elements into either/or choices, actions, and interpretations, obscuring their inherent interdependence.

Methods

Design

In this study, a deductive methodological approach was employed, using previous research as a foundation to extend the framework for efficient hospital-wide patient flows presented by Åhlin et al. (13), with new perspectives. This framework informed both the data collection method and the analysis of the study subjects' environment, challenges, and contextual factors. However, a thematic analysis of the collected data was also conducted using an inductive research approach to thoroughly explore the subjective perspectives of the study participants, as recommended by Braun and Clarke (39), and Dixon and Woods (40). This approach was chosen instead of predefining categories based on prior research. To further interpret the complexity and inherent tensions identified in the data, paradox theory (33) was employed as an analytical lens. This theoretical perspective enabled a deeper understanding of how seemingly contradictory demands and dynamics coexist and shape hospital-wide patient flow. Finally, the emerging themes from the thematic analysis, viewed through the lens of paradox theory, were integrated back into the framework to refine and expand its applicability.

Data Collection

In-depth, semi-structured interviews were conducted as the primary data collection method, following an interview guide (see Appendix A) to ensure consistency across interviews while allowing participants the flexibility to freely share their perspectives (41). The interview questions were designed to explore the barriers and enablers of hospital-wide patient flow while remaining open to emergent themes and new insights. Hospitals were selected through purposeful sampling to ensure a diverse representation of healthcare professionals from both secondary care (services provided by medical specialists, often at hospitals, who in general do not have the first contact with patients) and tertiary care (highly specialized care delivered in a hospital or similar care setting) (42). Six Swedish hospitals, three tertiary care providers, and three secondary care providers were included in the study. Initial contact was made with the general directors of the selected hospitals, who were provided with information on the study's purpose and asked to facilitate access to nurses and physicians actively engaged in patient flow management. Nurses and physicians were chosen as study participants, as they represent the two predominant healthcare professions most directly involved in patient flow. Upon receiving the study invitation, the general directors referred the research proposal to relevant department managers who subsequently identified and facilitated contact with eligible participants. To capture perspectives from different hospital settings, healthcare managers were asked to recruit participants from emergency settings (EDs), surgical settings (surgical clinics, inpatient care units, and operating units (ORs)), and medical settings (medical clinics and inpatient care units). Eligibility criteria required that participants (i) had no managerial responsibilities and (ii) had been employed and working in the same role for more than one year. Each hospital provided five participants, with one or two individuals from each setting, resulting in a total of 30 interviews conducted between May and October 2023, see Table 1. No participant chose to withdraw from the study. To ensure transparency, the interview guide was shared with all participants in advance. Interviews were conducted online via Zoom by a single researcher, with each session lasting between 55 and 70 minutes.

Table 1: Interview study participant list

Hospital Case	Hospital type	Hospital setting	Clinic setting	Healthcare profession
A	Tertiary care	Emergency	ED	Nurse
		Surgery	Clinic	Physician
		Medicine	Clinic	Physician
		Surgery	Ward	Nurse
		Emergency	ED	Physician
B	Tertiary care	Medicine	Clinic	Physician
		Surgery	OR	Nurse
		Emergency	ED	Physician
		Medicine	Ward	Nurse
		Surgery	Clinic	Physician
C	Secondary care	Surgery	Clinic	Physician
		Surgery	Ward	Nurse
		Emergency	ED	Physician
		Medicine	Ward	Nurse
		Emergency	ED	Nurse
D	Secondary care	Medicine	Clinic	Physician
		Surgery	Ward	Nurse
		Emergency	ED	Nurse
		Medicine	Ward	Nurse
		Surgery	Clinic	Physician
E	Secondary care	Emergency	ED	Nurse
		Surgery	Clinic	Physician
		Medicine	Clinic	Physician
		Emergency	ED	Physician
		Medicine	Ward	Nurse
F	Tertiary care	Medicine	Ward	Nurse
		Surgery	Clinic	Physician
		Emergency	ED	Nurse
		Medicine	Ward	Nurse
		Emergency	ED	Physician

Data Analysis

All interviews were recorded and transcribed verbatim. During the interview process, extensive notes were taken, and early potential themes were identified. This was followed by an open coding of the transcripts, aiming to capture all perspectives shared by healthcare professionals regarding the factors that either hinder or facilitate hospital-wide patient flow. Each code was classified as either a barrier or an enabler to ensure a comprehensive representation of viewpoints. The coding process followed an iterative approach, with emerging themes continuously analyzed to refine categorizations and identify patterns. This ensured that the analysis remained grounded in empirical data rather than being constrained by pre-existing frameworks. Once all open codes were established, they were aggregated into broader themes, progressing toward higher levels of abstraction. Toward the final stages of analysis, however, it became apparent that the most striking characteristic of the thematic patterns was paradox. Time and again, healthcare professionals articulated an ideal vision of how things should be, while simultaneously describing experiences that starkly contrasted with these ideals. They expressed core values intended to guide the development of healthcare organizations, yet the resulting realities often contradicted those very principles. Consequently, it felt compelling to explore literature on how to understand paradoxes and contradictions within organizations. Hence, the dynamic organizing model of paradoxes proposed by Smith and Lewis (33) was applied to the data set. Within this framework, the first aspect of the model was used, addressing the emergence and recognition of paradoxical tensions, as well as the last step, which examines strategies for resolving these tensions. The third step was deliberately omitted, which explores the cyclical responses to paradoxes, as the primary objective was to identify existing barriers and evaluate optimal strategies for their resolution rather than analyzing how organizations transition between different management approaches over time. Accordingly, in the subsequent data analysis, the paradoxical tensions revealed by the previously identified themes of barriers were examined. How these tensions were initially latent and what factors rendered them salient were also investigated. Finally, the solutions proposed by healthcare professionals were explored, aiming to resolve these paradoxical tensions in the context of enabling efficient hospital-wide patient flow. Hence, as part of the thematic coding process, participants' descriptions of actions, structures, or strategies that either mitigated existing tensions or offered alternative approaches to overcome barriers were examined. These responses were often embedded in broader narratives about what participants believed should change to improve flow. Codes related to "desired changes" or "suggested improvements" were clustered and analyzed in relation to the identified paradoxes. Last, the paradoxical resolutions were mapped onto the existing framework for hospital-wide patient flow developed by Åhlin et al. (13) as bottom-up solutions to complement the existing top-down solutions. For a full overview of the analytical process and framework integration, see Figure 3.

Stage	Approach	Purpose	Description	Outcome / Emerging Themes
1. Interview design	**Deductive**	Ground data collection in existing knowledge	Interview guide developed using Åhlin et al.'s (2023) framework on hospital-wide patient flow	Interview guide
2. Initial coding	**Inductive (open coding)**	Capture participants' lived experiences and perspectives	Verbatim transcripts coded without pre-set categories; codes labeled as barriers or enablers	650 open codes identified (e.g., "*Medical priority always takes precedence over logistical priority* " or "*the hospital is designed so that everyone only sees their small part of the patient flow* ")
3. Theme development	**Inductive thematic analysis**	Identify recurring patterns in the data	Codes clustered into broader themes using constant comparison	Themes such as: *"Responsibility and competence mismatch" or "Lack of hospital-wide understanding"*
4. Theoretical interpretation	**Theory-driven (Paradox Theory)**	Deepen understanding of tensions in themes	Themes re-analyzed using Smith & Lewis' (2011) model of paradoxes (focusing on paradox emergence and paradox resolution)	Key paradoxes identified: *"Autonomy vs. Uniformity" or "Misaligned mandates". Resolution paradoxes identified: "Build clearer flow strategy" or "Improved nurse flow mandate"*
5. Integration with framework	**Deductive synthesis**	Refine and expand existing framework	Emergent themes and paradoxes mapped back to Åhlin et al.'s (2023) framework to highlight gaps and new insights	The revised framework includes bottom-up solutions to complement previous top-down approaches to hospital-wide patient flow.

Figure 3: Overview of the analytical process and framework integration

Results

This study identifies seven paradoxes experienced by frontline healthcare professionals associated with hospitals' efforts to enable efficient hospital-wide patient flow, see Table 2. The characteristics of each paradox are outlined below and supported by representative quotes from the interviews. In total, the interviews generated 650 unique opinions and recommendations, which were synthesized into these seven paradoxes. Table 2 presents a structured overview, beginning with a description of each paradox and the associated latent tensions. It then outlines the salient tensions that emerge and the rendering factors that transform these tensions from latent to salient.

Table 2: Seven paradoxes to efficient hospital-wide patient flow

Paradox	Latent tension	Salient tension	Rendering factor
1 ***Local focus vs. system needs*** *Unit-level loyalties conflict with system-wide flow coordination*	Collaborative issues Unclear operational priorities Ambiguis flow objectives	Overcrowding Clinic expansions	Scarcity (Change) (Plurality)
2 ***Individualization vs. standardization*** *Specialized care discourages rigidity, but flow needs structure*	Scheduling challenges Slow patient transfer Operational inflexibility	Overcrowding Multimorbid patients Lack of OR capacity	Scarcity (Plurality)
3 ***Misaligned mandates*** *Doctors hold authority, but nurses grasp patient flow*	Congestion consequence unawareness Needing coordinating assistance Slow patient progression	Overcrowding Long LoS patients Unmet discharge planning	Scarcity Change
4 ***Seeking control, finding disorder*** *Staff aim for workflow control but face constant disruptions*	Stressed doctors Needing coordinating assistance Deprioritization of flow	Overcrowding Unmet discharge planning Long LoS patients	Scarcity
5 ***Autonomy vs. uniformity*** *Compliance is expected, but autonomy often overrides routines*	Altered treatment plans Lack of long-term planning Unpredictable work days	OR schedule overshooting Incomprehensible decisions Overcrowding	Plurality Change (Scarcity)
6 ***Proactive ideals, reactive reality*** *Flow planning requires foresight, but care remains reactive*	Short planning horizon Little proactive planning Stressful last-minute actions	Long LoS patients Unmet discharge planning Foreseeable avoidable bottlenecks	Change Scarcity
7 ***Data emphasis, flow blindness*** *Statistical feedback abounds, yet neglects patient flow*	Low flow performance feed-back Unmotivating metrics Lack of best practice comparison	New productivity requirements Unsatisfying performance	Change

Paradox #1: Local focus vs. system needs

Unit-level loyalties conflict with system-wide flow coordination

Healthcare staff across the studied hospitals describe a persistent tension between local initiatives to improve patient flow and the lack of a coherent, hospital-wide flow strategy. While some departments actively engage in

identifying and addressing their own flow-related bottlenecks, many participants report that these efforts occur in isolation, without a shared framework or guidance from hospital management. This results in a fragmented approach where each unit seeks to optimize its own operations, often at the expense of system-wide flow, and where hospital management may discuss patient flow, but these discussions seldom transform into something tangible for frontline healthcare professionals.

"I imagine a bunch of managers having a picture of how the patient flow should be done. But how is it communicated down? In my world, it doesn't seem to be. It doesn't seem to trickle down to all the different units, but gets stuck somewhere along the way." – [nurse, emergency department, tertiary care hospital, case A]

This situation reveals a paradox: individual departments are encouraged to take initiative and improve their own internal processes, yet these localized efforts can inadvertently hinder broader coordination. When units develop flow routines tailored to their own needs, they often do so without accounting for dependencies on, or consequences for, adjacent departments. In doing so, they may create new bottlenecks, reinforce siloed practices, or resist taking responsibility for patients whose care trajectories do not align neatly with their own optimized processes.

"The general goal is for the flow of patients to go quickly but each department gets to develop its own routines. However, no one connects them across the hospital, so that it is really a working plan, put in place in different departments or different parts of the hospital, to really provide some improved flow. That is what we would need" – [physician (surgeon), surgical clinic, secondary care hospital, case D].

This paradox becomes especially visible during periods of crowding or capacity strain, when the lack of central coordination leads departments to prioritize their own patients or avoid taking new ones, exacerbating flow issues elsewhere. Efforts to improve flow at the unit level, while well-intentioned, can thus undercut system-wide performance, revealing a core contradiction between the need for local control and the necessity of centralized coordination. Participants express a desire for hospital management to resolve this tension by developing a clear, overarching flow strategy that aligns local initiatives with shared, cross-departmental goals. Yet, the very autonomy that empowers local problem-solving also entrenches siloed behavior, illustrating the difficulty of achieving both localized responsiveness and system-level integration, a hallmark of paradoxical demands in complex healthcare systems.

Paradox #2: Individualization vs. standardization

Specialized care discourages rigidity, but flow needs structure

Nurses and physicians often oppose the standardization of healthcare processes, emphasizing that the healthcare system must remain responsive to each patient's unique set of problems. They stress the importance of individualized care, particularly in complex or multi-morbid cases. Yet, at the same time, many participants observe a strong and ongoing trend toward increased standardization, driven largely by the growing specialization of medical expertise, and to some extent, by changes in nursing practice. This shift is often justified by the belief that specialization leads to higher quality care through deep domain-specific knowledge and more efficient, repeatable routines. Participants note, however, that patients increasingly present with multiple concurrent symptoms and diagnoses. In the past, such patients could more easily be categorized and assigned to the most appropriate department. Today, increased specialization has made interdepartmental transfers more difficult, as departments are often reluctant to admit patients whose conditions fall outside their narrow areas of expertise. This protectionism becomes particularly problematic during periods of hospital overcrowding, when the ability to move patients swiftly between departments is critical to maintaining flow.

"Take, as an example, an oncology patient with brain metastases quite far along in their disease, who has palliative treatment in its final stages. They come into the emergency room with neurological problems and a headache. All signs that there is a process in the brain. Then there can be a tug of war, or rather a push and pull, between the neurologist and oncologist about who should take care of the patient. When the oncologist says that this is an isolated neurological problem and the neurologist says that this is a complex oncological disease with an expected outcome that the oncologist can absolutely treat. But, the oncologist is full. The neurologist has one place left. It can be a discussion that can last for hours while the patient remains in the emergency room." - [physician, emergency department, tertiary care hospital, case F]

This illustrates a core paradox experienced by healthcare professionals: while specialization and standardization are intended to enhance quality and efficiency, they simultaneously reduce the flexibility needed to care for patients with complex conditions. The very structures designed to streamline care for well-defined patient cohorts end up slowing care and creating bottlenecks when faced with real-world clinical complexity. The same dynamic

is present in surgical planning. Surgeons are increasingly sub-specializing, narrowing the range of cases they are willing or able to treat. As a result, the surgical schedule becomes highly rigid, with minimal operational slack. Any fluctuation, such as an unexpected staff absence or a surge in a particular patient group, can lead to cascading delays or canceled procedures. Despite this, there remains a strong professional belief that greater specialization improves medical quality. However, that same specialization requires greater standardization and more homogenous patient cohorts, which many healthcare professionals resist, particularly when treating diverse, acutely ill, or multi-morbid patients.

"The trend in the hospital, and healthcare in general, towards becoming increasingly specialized means that it is a fairly fine-meshed net for patients to get through to get the care they need, and the flow of patients is slowing down." - [physician, medical clinic, tertiary care hospital, case B]

Thus, the paradox lies in the tension between the push for standardization (through specialization) and the reality of increasingly complex patient needs. Instead of adapting care structures to fit patients, patients are expected to conform to increasingly rigid organizational logics. This reverses the ideal of patient-centered care, and undermines both patient flow and care quality for those who don't "fit the mold."

Paradox #3: Misaligned mandates

Doctors hold authority, but nurses grasp patient flow

Healthcare professionals operate based on various underlying logics that influence their reasoning, work ethics, and areas of focus. A notable distinction frequently observed by both physicians and nurses is that nurses often possess a more intuitive understanding of patient flow compared to physicians. Nurses are typically trained to consider the patient's entire care trajectory, attending to the need for coordination to ensure continuous progression along this journey. In contrast, physicians tend to focus primarily on the immediate clinical condition of each patient, making medical assessments and treatment decisions based on acuity, rather than on the broader implications for overall system flow.

"There is a lot to remember to do and it feels very extensive. It is very complex. At the same time, we are faced with this problem that we cannot do everything with everyone. At the same time, we are not used to thinking about flow either. If I do this for this patient now, is someone else being displaced? We are not trained in it that much." – [physician, medical clinic, secondary care hospital, case C]

This dynamic gives rise to a fundamental paradox: although nurses often have a better grasp of patient flow and its operational implications, the legal and clinical authority to make decisions about patient progression lies solely with physicians, who may lack that flow-oriented perspective. As a result, responsibility and insight are misaligned. The professionals most attuned to optimizing patient movement through the system are structurally unable to act on that knowledge, while those empowered to make decisions may inadvertently contribute to bottlenecks by focusing narrowly on clinical priorities. This paradox becomes particularly visible in inpatient wards, where less medically urgent patients may be deprioritized and left waiting for discharge decisions, often at the very end of the ward round. Nurses, despite playing a central role in coordinating patient logistics, are left to manage the downstream effects of delayed discharges and inefficient planning, without the formal authority to directly alter those plans. The result is growing frustration and inefficiencies in patient flow. Several participants emphasized the need for closer collaboration between professional groups and more integrated decision-making processes. Some suggested that nurses should be granted greater authority to support and influence discharge planning and flow coordination. Similar issues arise in the context of surgical scheduling, where decisions made by surgeons are largely based on clinical urgency, without always accounting for the impact on postoperative units or downstream bed availability. During periods of hospital overcrowding, these blind spots in flow awareness can significantly exacerbate congestion and delay care for others.

"The surgical program could really be designed more according to the consequences it has on our departments. It feels like the surgeons only plan surgeries based on medical priority and very rarely based on what benefits the flow the most. Patients have much more predictable treatment times than many seem to believe and thus the flow out could be much smoother." – [nurse, medical ward, tertiary care hospital, case A]

Thus, the paradox centers on a structural misalignment between authority and flow knowledge: those with the best operational insight into patient movement lack decision-making power, while those with decision-making power often lack awareness of system-level consequences. Breaking this paradox requires rethinking how responsibility is distributed and how collaboration is structured to better align expertise, authority, and accountability in the management of patient flow.

Paradox #4: Seeking control, finding disorder

Staff aim for workflow control but face constant disruptions

Hospitals are frequently characterized as among the most complex organizations in existence. They manage the simultaneous care of large numbers of patients with diverse needs, ranging from acute and semi-acute to scheduled and chronic conditions, while delivering advanced treatments that require coordination across multiple medical specialties and the integration of sophisticated technological and clinical systems. Amidst this complexity, many physicians and nurses in this study underscore the substantial cognitive burden placed on senior doctors, who are expected to retain and process vast volumes of information each day to oversee the progression of all patients under their care. This challenge becomes particularly acute during periods of overcrowding, when numerous critical decisions must be made concurrently under intense time pressure.

"It happens that I forget things, not because I'm careless, but there are many things to do at the same time. I have to focus on a task. In many cases you don't even have the opportunity to take notes. It can happen that I get a call and I'm standing in a sterile gown operating or doing something. It means a lot of stress, in some cases an extremely high workload, and basically almost every day I feel that I'm not satisfied with certain parts of my work. I'm fully aware that I don't have time to do everything that needs to be done. I simply forget certain things." – [physician (surgeon), surgical clinic, secondary care hospital, case E]

This points to a core paradox in how work is organized in hospitals: although the complexity of care demands shared responsibility and distributed coordination, the system continues to concentrate information processing and decision-making on a few key individuals, most often senior physicians. As complexity increases, so does the expectation that individual clinicians will independently manage and remember an overwhelming volume of details, even though this is cognitively unsustainable. The substantial volume of information that must be retained often results in critical details being overlooked, necessitating that nurses devote considerable time to supporting physicians with prioritization and coordination tasks.

"Doctors sit and read beforehand, but might not take into account checking whether the patient has anything else planned, and then it's a bit of luck whether the patient is in the room or not. Quite a lot is up to me anyway, to keep track of different parts and sort of coordinate a bit so doctors don't miss important things. Then, we also have social coordinators on the ward who help with care planning and such. And when they are involved, they can be a good support. Either way, if we believe that a patient is going home on a certain date, then we have to think about preparing many things, and unfortunately, many things fall between cracks." - [nurse, medical ward, secondary care hospital, case D]

Despite various efforts to introduce tools and roles to support coordination, the cognitive demands remain disproportionately individualized. Under conditions of overload, professionals tend to focus primarily on the most critically ill patients, increasing the risk that patients with less acute conditions are neglected, particularly those who remain hospitalized beyond their expected discharge dates. Both nurses and physicians point to the negative consequences of concentrating too much responsibility on too few individuals, and consistently call for a more equitable distribution of responsibilities. They highlight the need for system-level tools capable of visualizing patient care processes and identifying next steps along the care trajectory. Such tools, they argue, could reduce reliance on individual memory and enhance workflow efficiency. Thus, the paradox lies in the tension between the collective nature of hospital work and the persistent individualization of responsibility. The system requires collaborative cognition and shared tracking of patient care, but simultaneously reinforces a structure where key individuals are expected to "hold it all in their heads", a practice that proves increasingly unsustainable under rising complexity and workload.

Paradox #5: Autonomy vs. uniformity

Compliance is expected, but autonomy often overrides routines

Healthcare exemplifies a routine-driven sector, where the use of checklists and treatment protocols is intended to safeguard high standards of medical care. However, findings from this study reveal a paradoxical tension: while standardization is widely promoted as a means to ensure predictability and efficiency, the culture of professional autonomy in healthcare actively resists such efforts. Most participants reported a lack of well-established routines, and even more commonly, a tendency among professionals, especially physicians, to deviate from existing protocols. These deviations are not always perceived as errors, but rather as expressions of clinical independence and responsibility.

"A physician decides something for a patient at the end of the week. Then another one comes along and says something completely different and changes the plans. The new physician wants to make her own opinion and assessment of the patient. It might take a day or two to do that. And then everyone starts with something new,

some new thought. And then the next week comes along with some new doctor again who wants to form their own opinion about the patient. So I think we have a lot to work with there, on continuity." – [nurse, medical ward, tertiary care hospital, case B]

This autonomy, while valued for enabling individualized care, also introduces significant unpredictability into the system. Colleagues often struggle to interpret shifting decisions, which can lead to frustration and redundancy. For example, treatment plans may be revised during shift changes, leading to repeated examinations or extended hospital stays, consequences that hinder rather than help patient flow. Experienced colleagues who work closely with patients often observe that these revisions rarely improve outcomes. Instead, many perceive that individual physicians prioritize their own judgment over shared protocols, even when existing guidelines are in place. The paradox becomes especially visible during periods of hospital overcrowding, where coordinated action is essential. In these high-pressure situations, sudden, unilateral changes in care plans can be deeply demotivating for staff and disrupt the flow of operations. A commonly cited example involves surgeons underestimating the duration of procedures, despite repeated experience showing otherwise. This leads to operating room schedules that overrun, staff working overtime, and increased variation in workload.

"Surgeons have been given operating blocks to deal with but plan surgeries so that they will be finished before the end of the block time even though they have never performed a surgery within the intended time. Then we have to work overtime. We usually realize this immediately when we see the schedule for the day. It doesn't feel great that the original planning and staffing schedules are not respected. It creates a lot of variation, unpredictability, and overtime work for the unit." – [nurse, operating room, tertiary care hospital, case F]

Thus, the paradox lies in the conflict between the system's need for standardization to reduce variation, crucial for managing patient flow efficiently, and the deeply rooted norm of professional autonomy, which fosters variation and unpredictability. While both sides aim to ensure high-quality care, they pull in opposite directions: one towards collective consistency, the other towards individual discretion.

Paradox #6: Proactive ideals, reactive reality

Flow planning requires foresight, but care remains reactive

Healthcare operates within a dynamic environment, where patients' conditions may improve or deteriorate rapidly, necessitating corresponding adjustments in healthcare operations. Professionals recognize that plans often shift throughout the course of a single shift, both with respect to patient treatment and the optimal allocation of resources such as staff, treatment rooms, and equipment. A recurring concern expressed in several interviews is that the planning horizon is often too short. Greater foresight in operational planning is seen as a potential enabler of more efficient patient flow. Frustration arises when patients remain in care longer than necessary simply because short-term planning prevents timely transitions or discharges.

"In the best of worlds, it would have been that we think more about the continuous patient trajectory, and I think it would have been better if you had a plan for the patient already when they are admitted. But unfortunately, it often happens that we only plan half days ahead, until next round, and after the round, and then until the following afternoon." – [nurse, medical ward, secondary care hospital, case C]

This points to a central paradox experienced by healthcare professionals: while there is a growing awareness of the value and feasibility of proactive, data-informed planning, daily practices remain entrenched in reactive routines. On one side of the paradox, staff express a strong belief that care trajectories can be predicted with relative certainty and that innovative technologies could enable a more forward-looking approach. On the other side, existing structures, routines, and decision-making cultures are optimized for short-term responsiveness, planning from round to round, which constrains the ability to act proactively, even when predictable patterns are known. Healthcare personnel perceive hospital bed coordination as predominantly reactive, lacking a strategic role in optimizing patient flow across the hospital or in planning patient movement with consideration for downstream effects. Many physicians and nurses express the view that a more clearly defined coordination structure, endowed with greater authority, would support more efficient transfers between the emergency department, acute care units, intensive care units, and hospital wards. Although many bottlenecks are predictable, the absence of centralized coordination often results in recurring delays in patient progression, which several respondents described as disheartening. Interviewees emphasized that patient care trajectories are more predictable than commonly assumed and suggested that a proactive, forward-looking approach to planning could significantly improve flow. Furthermore, new technologies, or innovative applications of existing technologies, were identified as potential tools to support healthcare professionals in adopting a more anticipatory strategy, enabling more accurate assessments of patient care trajectories through the application of statistical analysis.

”Patients come in clear prototypes, and you can determine with a fair amount of certainty how many days they will need to be cared for. And with new technology, we should be even better at being able to determine when a patient is likely to be discharged. This allows us to be much more proactive in care planning, than we are many times today, and several days before discharge, with everything that needs to be done.” – [physician (surgeon), operating room, secondary care hospital, case D]

Thus, the paradox lies in the tension between the acknowledged potential for proactive planning and the deeply embedded reactive modes of operation. Despite having tools, data, and knowledge to plan ahead, the system remains stuck in short-termism, a cycle driven by immediate pressures, fragmented responsibilities, and an underdeveloped coordination structure.

Paradox #7: Data emphasis, flow blindness

Statistical feedback abounds, yet neglects patient flow

Improving performance necessitates an understanding of current performance levels. While healthcare providers routinely engage in extensive measurement, particularly through the continuous monitoring of medical quality outcomes, which is central to healthcare operations and development, the use of metrics related to patient flow appears inconsistent. When asked whether they utilize indicators reflecting patient flow performance, physicians and nurses offered varied responses. Some reported using flow-related metrics, such as Length of Stay (LoS), average discharge time, and the average number of discharges before noon. Others, however, indicated that they do not employ any measures specifically linked to patient flow.

“No, we no longer get any information about whether we perform well or badly or how many patients we are discharging at a certain time. I actually have no idea about anything related to patient flow, we get no feedback.” – [nurse, surgical ward, secondary care hospital, case E]

A few respondents reported receiving feedback from management, although this occurs infrequently. Notably, all participants working in units that employ flow metrics perceived these measures as lacking motivational value. While the metrics themselves were not viewed as inherently problematic, the associated performance targets were frequently described as unrealistic and largely unattainable. Consequently, participants expressed low motivation to engage with these measures and reported little effort to meet the prescribed targets.

“Even though there are a lot of things measured in association with surgical procedures related to the flow of patients, few or no one directly follows them or cares. The goals are not realistic, either. They are simply not motivating. That is a problem.” – [physician (anaestesiologist), operating room, tertiary care hospital, case F]

This situation reflects a paradox: while staff are expected to take ownership of and contribute to improving patient flow, a key hospital performance goal, they are simultaneously deprived of the feedback and actionable data needed to guide or assess such improvement efforts. On the one hand, flow metrics are framed as essential to efficient operations; on the other hand, those closest to the work are not systematically informed about these metrics or involved in interpreting them. This disconnect undermines staff agency and accountability, creating a situation in which responsibility is assigned without providing the means for responsible action. Moreover, the consequences of failing to measure patient throughput performance often become apparent when new management or hospital leadership express dissatisfaction with production outcomes and introduce new performance targets or staff-to-patient ratios. In such cases, the unit may lack the necessary data to assess its current capabilities, determine the feasibility of the new requirements, or predict the impact of these changes on patient flow performance.

Resolutions to paradoxes

This study identifies seven paradoxes that impede healthcare professionals' efforts to improve patient flow across hospital systems. While illuminating such paradoxes and contradictions in healthcare delivery is valuable, the initial aim of this research was to deepen the understanding of hospital-wide patient flow challenges and explore potential solutions. Drawing on the perspectives of frontline healthcare professionals, this study presents a series of proposed resolutions to the identified paradoxes, see Figure 4. The resolutions are organized around the seven paradoxes. *First*, for an improved patient flow, participants advocated for stricter adherence to shared routines, improved continuity in staff scheduling, and greater transparency in planning processes. These measures were seen as fostering compliance and predictability in daily operations.

“We need to have much better consensus on the path the hospital has chosen and the routines in place so that everyone sees the flow in the same way and understands it." – [Physician (surgeon), surgical clinic, secondary care hospital, Case E]

Second, participants called for strengthened central coordination of patient flow, underpinned by a hospital-wide strategy and inter-organizational collaboration. Some respondents emphasized the need for a designated coordination function or team to ensure alignment across units.

"There needs to be someone, or a team of people, who connects the pieces to ensure that there is a functioning plan for the different parts of the hospital, a plan that will truly lead to improved patient flow." – [nurse, ward, tertiary care hospital, case F]

Third, to reduce systemic rigidity, participants suggested expanding the competence profiles of staff. For example, requiring nurses and physicians to take on broader roles and competencies in parallel to their specialization in a medical subfield was proposed as a way to improve operational flexibility. Others emphasized the need for a centralized mandate or authority, a flow coordinator or team, empowered to make real-time placement decisions. *Fourth*, improved control over workflows was linked to both better IT support and more distributed responsibility among clinical staff. For instance, developing patient logistics systems that may aid clinicians in managing a pressing situation, and better balancing decisions between what is important for both individual patients and the general patient flow.

"There needs to be a more automated system, a medical records system where you could see where in the chain the patient is, so that all parties can see the patient's location, what is supposed to happen next, and where the bottlenecks occur." – [nurse, medical ward, secondary care hospital, case D]

Fifth, a more proactive approach to care delivery, such as earlier discharge planning and anticipatory bed management, was tied to stronger central oversight and supportive IT tools. Several participants described the need to shift from reactive to anticipatory planning.

"We need better forecasting tools for improved proactive planning of patient care trajectories. We need to be able to discuss earlier in the process whether things are possible or not. We need to know things together weeks in advance so that the surprises are reduced." – [physician (anaestesiologist), operating room, tertiary care hospital, case F]

Sixth, participants stressed the importance of visible and engaged leadership. They called for the development of performance metrics that reflect actual flow dynamics and can be used meaningfully in daily work. These metrics should be used not only for accountability but also for motivation and collective learning. *Seventh*, to address professional silos, participants highlighted the need for greater involvement of nurses in flow-related decisions and more regular interprofessional communication. Several called for routine joint planning meetings or daily huddles involving both medical and nursing staff to promote a shared understanding of patient flow dynamics.

"Throughout the entire process, there are many, many parties involved, and the problem arises when you have to move from your own domain into someone else's, that's when it starts to become a bit problematic because you need help from someone else. That's why we need to meet each other more, both informally and formally." – [physician (surgeon), surgical clinic, secondary care hospital, case D].

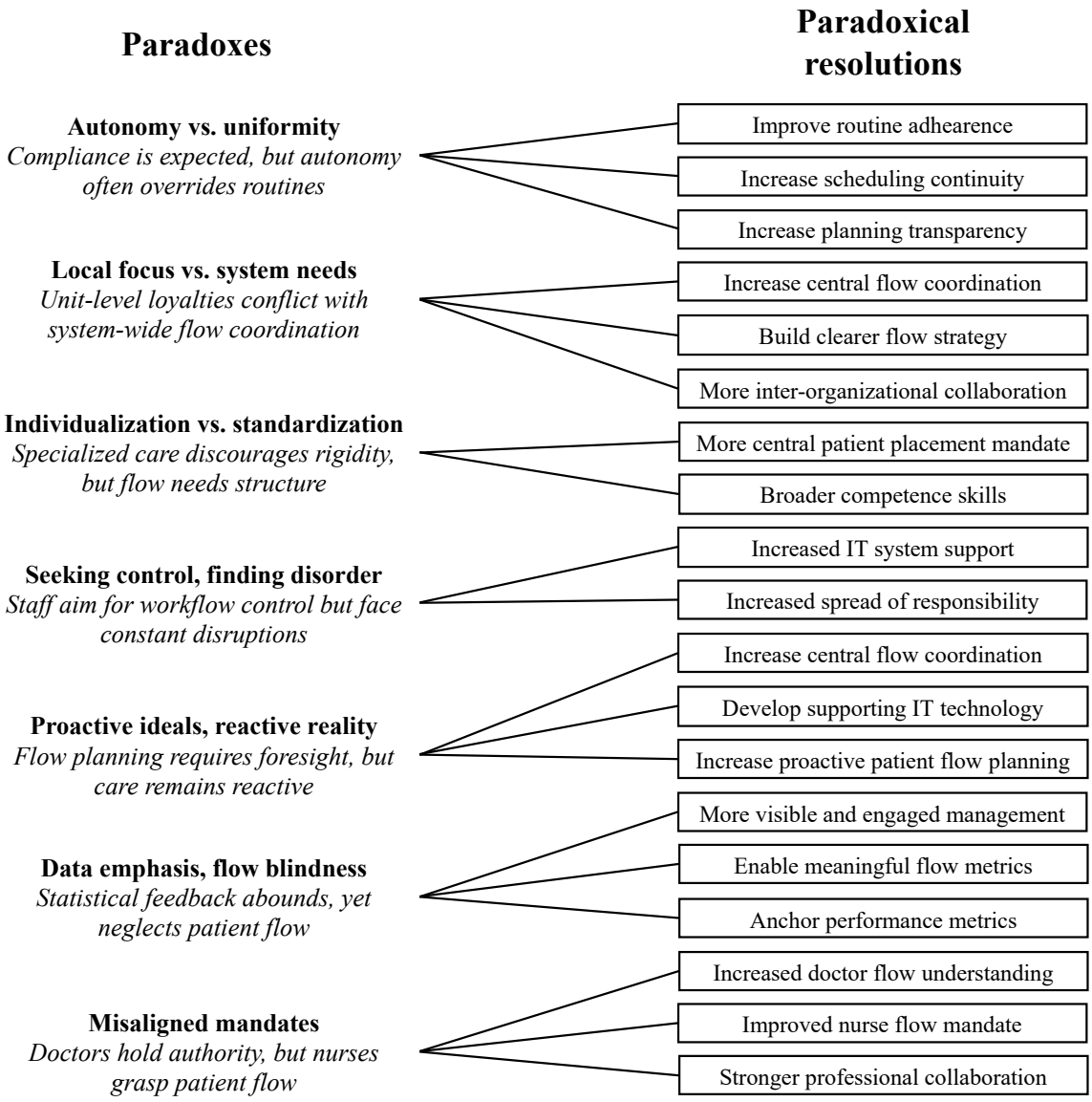

Figure 3: Paradoxes and resolutions to hospital-wide patient flows

Taken together, these proposals represent a bottom-up perspective on resolving systemic tensions and paradoxes. While some of the suggestions align with existing best practices (e.g., flow coordinators, IT systems for patient tracking), others reflect deeper organizational changes, such as the redistribution of decision-making authority and redefinition of professional roles.

Discussion

Improving patient throughput at hospitals is crucial to meeting the growing demands of future healthcare, and prior research highlights that enhanced patient flow is a key factor in boosting hospital productivity (5-8). As patients increasingly navigate complex care pathways involving multiple professionals, departments, and administrative units, a system-wide perspective has become essential (11-14). However, most existing studies on hospital-wide patient flow have focused on managerial perspectives and strategies, largely overlooking the experiences of frontline healthcare professionals, those who interact most directly with patients throughout their hospital journey. Although healthcare professionals often articulate a clear idea for achieving efficient patient flow through their organizations, their experiences frequently diverge from those ideals. They uphold core organizational objectives and values, yet routinely encounter situations that contradict them. Based on these findings, this study identifies seven paradoxes associated with enabling efficient hospital-wide patient flows in which non-managerial staff at large hospitals perceive direct conflicts among the hospital's stated values, philosophies, and objectives. These contradictions contribute to a work environment characterized by frustration, stress, and unpredictability.

Paradoxes in patient flow have been previously studied by Kreindler (14), who examined systemic barriers by conducting interviews with a large number of hospital managers within a Canadian region. The study identified three key paradoxes: (1) "initiatives improve parts of the system but fail to address underlying systemic constraints," (2) "local innovation clashes with regional integration," and most notably, (3) "rules that improve service organization for my patients create obstacles for yours." A common theme among these paradoxes, as identified by Kreindler (14), is their emergence largely due to the absence of a system-wide approach to patient flow and its optimization. Enhancements in one part of the system often create unintended challenges elsewhere, and such improvements may not align with the workflows of the broader system. This study confirms but also refines these paradoxes, emphasizing that while autonomy benefits independent actors, it can disadvantage those who depend on others. Similarly, while specialization alleviates burdens for some, it often shifts the workload onto others.

This study highlights the strong institutional belief in the capacities of physicians, leading hospitals to assign them mandates and decision-making responsibilities that they may not be equipped to fully comprehend or manage. Delegating certain physician responsibilities to other professional groups appears not only beneficial for patient flow but also advantageous for the professional development and effectiveness of physicians (43, 44). These paradoxes further underscore the perspectives of many healthcare professionals, who argue for designing workflows based on patient movement rather than the rigid structures of medical specializations (6). Many professionals find the prevailing local focus on patient flow, coupled with a reactive rather than proactive organizational approach, increasingly outdated, especially in light of technological advancements and emerging organizational models that support a more anticipatory healthcare system (13). Finally, choosing not to provide meaningful feedback on patient flow performance to healthcare professionals, despite the centrality of medical quality in hospital performance, appears unwise. Patient flow directly impacts individual patients, facilitating faster transfers and reducing iatrogenic complications, while also improving healthcare system efficiency by increasing overall accessibility (10, 45).

Importantly, this study also sheds light on the tension between efficiency and quality of care, an issue that has been documented in earlier work but remains under-acknowledged in implementation efforts. As observed by Nugus and Braithwaite (31), the drive to streamline patient throughput often competes with clinicians' professional commitment to individualized, patient-centered care. Similarly, Benjamin (30) highlights how emergency nurses perceive flow initiatives and standardized procedures as sometimes undermining their capacity to provide quality care. Our findings echo this concern: although frontline healthcare professionals frequently recommend increased use of standardized routines and schedules, they also express resistance when such measures are perceived as overly rigid or misaligned with patient needs. This ambivalence suggests that standardization, while essential for system coordination, must be balanced with professional discretion and context-sensitive judgment. A more nuanced approach to flow improvement may be required, one that recognizes the legitimacy of frontline concerns and incorporates flexibility within standardized processes.

Most of the paradoxes discussed above stem from some form of scarcity, whether of beds, staff, space, or operating room (OR) time. Healthcare professionals frequently encounter resource constraints and often attribute inefficient patient flow to a lack of adequate resources. The emergence of bottlenecks is one of the most common indicators of systemic inefficiencies (7). For instance, when auxiliary beds are required due to ward overcrowding, deficiencies become apparent. Similarly, when OR cases consistently exceed scheduled capacity, forcing staff to work overtime for consecutive days, the limitations of the system become unmistakable. Paradoxes also arise in response to change, whether through modifications in routines, new regulatory requirements, or the expansion and restructuring of services. People are generally resistant to change, particularly when it is perceived as irrational or difficult to comprehend, which often brings paradoxes to the forefront (37). Additionally, some paradoxes emerge due to plurality, conflicting ideas, interests, or mandates, and decision-making processes (36). These tensions become evident when there is disagreement over where to place multimorbid patients or when a culture of professional autonomy leads to shifts in patient care trajectories with every change in staff. This study, however, underscores that many of these paradoxes, whether driven by scarcity, change, or conflicting interests, can likely be mitigated through enhanced system-wide collaboration, a deeper understanding of patient flow dynamics, and greater adherence to standardized routines and operational planning. These findings also align with previous research advocating for reducing unnecessary variation in healthcare processes to improve overall efficiency (13). Yet, as our findings and prior literature suggest, such adherence must be sensitive to the perceived trade-offs between quality and efficiency. Without addressing these tensions directly, top-down flow initiatives may encounter resistance or be inconsistently implemented.

This study offers a bottom-up perspective that complements the patient flow improvement framework proposed by Åhlin et al. (13), which is grounded in the viewpoints of healthcare managers. The association between paradoxes and paradoxical resolutions presented in Figure 3, has, therefore, been linked to the solutions categories presented in the framework on hospital-wide patient flows (Figure 1) by Åhlin et al (13) in a comparison of bottom-up and top-down solutions for the improvement of hospital-wide patient flows, see Figure 4.

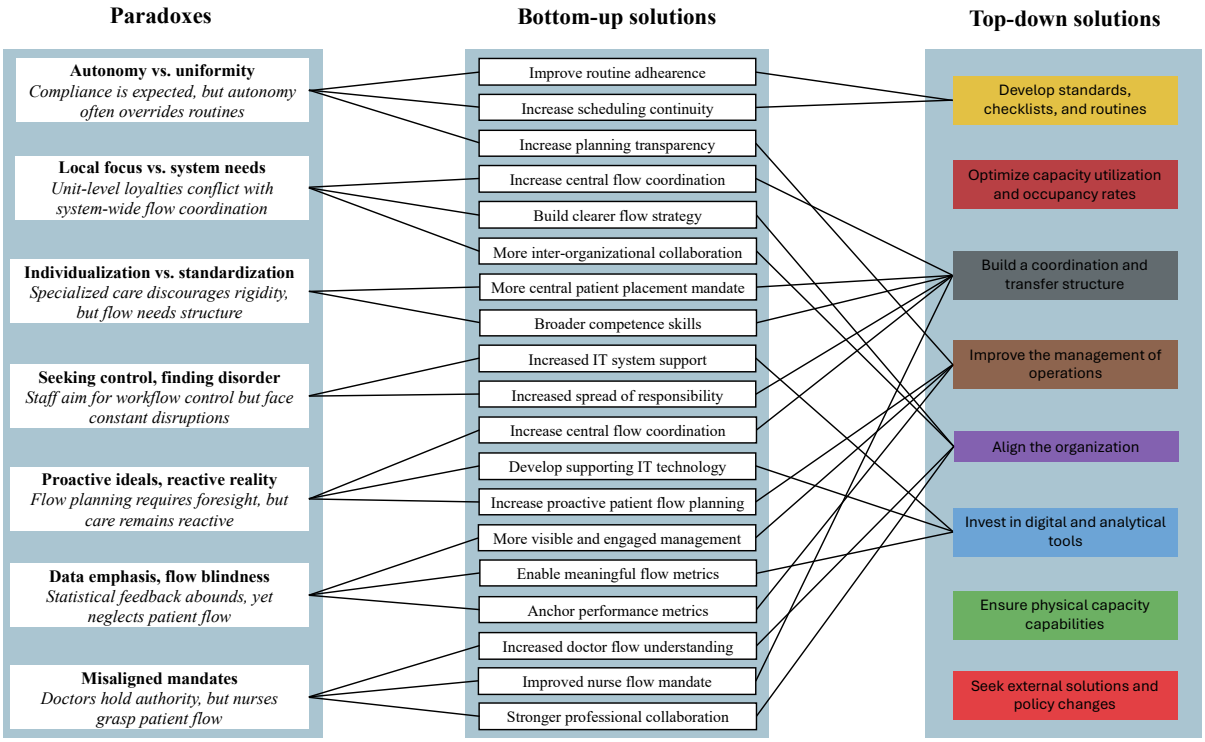

Figure 4: Comparison of bottom-up and top-down solutions for the improvement of hospital-wide patient flows

This comparison shows that frontline healthcare professionals largely align with senior management in their views on how to enhance hospital-wide patient flow. Similar to senior leaders, frontline healthcare professionals emphasize the importance of *developing standards, checklists, and routines,* as they highlight the need to improve adherence to routines and set schedules. However, their support for standardization is often conditional—dependent on whether these routines are perceived as enhancing, rather than constraining, their ability to deliver high-quality care. They also see the benefits of *building a coordination and transfer structure,* as they highlight the need for central flow coordination and placement mandate, but also the need to expand and better use competencies among healthcare professionals to promote patient flow. Healthcare professionals also highlight the need for *improving the management of operations* by making production planning more transparent and proactive, and using more meaningful flow metrics, as well as making the management more visible and engaged in patient flow improvements. *Aligning the organisation* is seen as important, enabling clearer flow strategies, increased system-wide understanding of the patient flow, and stronger collaboration between both professional groups as well as inter-organisational units. Last, they also want to *invest in digital and analytical tools* to improve the support healthcare professionals can receive from IT systems and to develop visible and better synchronized flow metrics across the organisation.

Concerning the three categories without connections: *optimize capacity utilization and occupancy rates*, *ensure physical capacity capabilities*, and *seek external solutions and policy changes*, no paradoxes or paradoxical resolutions seem to be associated. The reason behind this is likely that they are associated with the factors rendering latent paradoxes salient instead of imposing organisational paradoxes on the patient flow. Smith and Lewis (33) explain that paradoxes evolve in the process of designing and forming organisations. In this study, healthcare professionals articulated an ideal vision of how to improve the flow of patients throughout their organisations, while simultaneously describing experiences that starkly contrasted with these ideals. The three top-down solution categories without connections to the bottom-up solutions seem to be more connected to needed resources (staff, beds, rooms, facilities) instead of work methods. Consequently, if these categories of solutions are met, i.e, when there is little resource scarcity, then the seven paradoxes identified in this study may remain latent without being rendered salient.

While this study identifies several paradoxes and bottom-up solutions that align closely with top-down strategies, it is essential to recognize the inherent complexity and unpredictability of hospital operations. Large hospital organizations are composed of numerous departments, professional groups, and workflows, each with specialized roles and interdependencies. The fluid and dynamic nature of patient care, particularly when faced with emergencies, comorbidities, and fluctuating demand, makes full alignment across all units inherently challenging. Healthcare professionals may share an overarching understanding of what improves patient flow, yet the sheer scale and variability of daily operations often limit the consistent application of these ideals. Therefore,

while system-wide strategies and collaboration are crucial, their implementation must remain adaptive and sensitive to the decentralized, often fragmented realities of hospital work.

A novel contribution of this bottom-up perspective lies in its focus on how healthcare professionals might reconfigure their roles, competencies, and responsibilities to better support patient flow. A critical issue identified is the misalignment between nurses' understanding of flow dynamics and their lack of authority to influence patient progression decisions. There seem to be two paths ahead: either hospitals need to expand nurses' mandates to progress patients along their care trajectories, or an enhanced collaboration between nurses and physicians becomes essential to ensure that flow-related knowledge is effectively translated into action, thereby improving overall patient throughput.

Limitations and Future Research

This study is subject to several limitations. Firstly, it relies on a single analyst. While employing multiple coders would have been preferable, rigorous participant validation ensured the integration of diverse perspectives. Additionally, the author has extensive training in employing qualitative research methods, having completed several research methods courses and multiple research projects. Also, peer debriefing has been employed to identify biases, challenge interpretations, and consider alternative explanations. A well-structured, semi-standardized interview guide was utilized, facilitating a more consistent comparison across participants. Furthermore, the study's robustness was enhanced by the substantial number of participants and the inclusion of six different hospitals, thereby strengthening the validity and generalizability of the findings. Another limitation pertains to the online format, as all interviews were conducted via Zoom. This virtual setting posed challenges in accurately capturing non-verbal cues such as body language and facial expressions, potentially constraining the comprehensive interpretation of participants' responses. Additionally, the researcher's background in Operations Management introduces inherent biases and preconceptions. This challenge is further reinforced by the researcher's prior professional experience in a hospital setting, collaborating closely with doctors and nurses, which may have influenced their understanding of the participants' challenges and perspectives.

There are several promising avenues for future research. One potential topic is to investigate the differences in patient flow management and outcomes across hospitals, particularly in relation to the extent of authority and autonomy granted to nurses. Another area of interest is examining how a hospital-wide focus on patient flow is operationalized at various managerial levels, and how it can be tailored to be meaningful and motivating at each level of the organization. Finally, it would be valuable to explore the appropriate degree of independence and autonomy that healthcare professionals, especially physicians, should be granted. While such autonomy is often regarded as essential for efficient and responsive healthcare, it can also introduce confusion, inconsistency, and unpredictability in the delivery of care.

Conclusions

This study examines the perspectives of frontline healthcare professionals regarding the factors that hinder and facilitate hospital-wide patient flow. Nurses and physicians report experiencing significant contradictions between the ideals guiding how work should be carried out and the realities of how it is actually performed. The analysis identifies seven key paradoxes related to leadership and organizational structures, routines and procedures, professional culture, and the use of technology and performance metrics. These paradoxes become particularly pronounced under organizational pressure, during changes to work routines, when patient care is compromised, or when staff are required to work overtime. The study presents multiple strategies aimed at addressing these paradoxes and enhancing the overall flow of patients throughout the hospital. Frontline healthcare professionals largely align with senior management on strategies to improve hospital-wide patient flow, emphasizing the need for aligned structures, objectives, and performance metrics. They advocate for centralized coordination, adherence to standardized routines, and responsive hospital designs. Importantly, professionals highlight the need to redefine roles and empower nurses, addressing the gap between their flow-related knowledge and limited decision-making authority. Strengthening nurse-physician collaboration is essential to translating this knowledge into improved patient flow.

Declarations

Ethics approval and consent to participate

This study has been conducted in Sweden according to Swedish laws and regulations. Participants were interviewed in their professional role, and no personal or sensitive information was obtained. According to the Swedish Ethical Review Act (*Lag om etikprövning av forskning som avser människor 2003:460*), this study does not need ethical clearance by a Regional Ethical Review Authority as it does not include any primary empirical data on biological material or sensitive personal information. No ethics approval has consequently been applied for before conducting this study. However, all participants have been informed about the purpose of the study and

their manager's knowledge of their participation in the study before agreeing to participate. Informed consent has been obtained from all participants, and all quotes have been approved by the party concerned before publication.

Consent for publication
Consent from each participant was confirmed in conjunction with each interview, and all cited participants have been contacted for approval before publication.

Availability of data and materials
All datasets generated or analyzed during this study are included in the main manuscript [and its supplementary information files].

Competing interests
The author declares that there are no competing interests concerning the material discussed in this manuscript. This accounts for interests of either financial nature (such as grants, consultancies, equities, or other employments) or non-financial nature (such as professional, personal relationships, or subjective beliefs).

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Authors' contributions
This study has been designed and conducted by one independent researcher. The manuscript has also only been written by the same independent researcher. The author of the manuscript is accountable for all aspects of the accuracy and integrity of the manuscript. The article is original and has not already been published in a journal and is not currently under consideration by another journal. The researcher agrees to the terms of the BioMed Central Copyright and License Agreement.

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Appendix A

Chalmers University of Technology

Interview Guide

Hospital-wide patient flows

1.	Describe what you do in your professional role at the hospital
2.	Describe the function of your unit/clinic within the hospital
3.	Describe in a bit more detail what a typical week at the hospital looks like for you.
4.	How would you describe what a patient flow is?
5.	How would you describe how you and your unit/clinic work to improve your patient flow?
6.	Describe your view of how your and your unit's/clinic's work is related to the flow of patients through the hospital's overall organization.
7.	How would you describe an effective flow of patients through the hospital's entire organization?
8.	Who do you believe is responsible for improving the flow of patients through your hospital?
9.	What is your view on how your hospital currently works to enable a more effective patient flow throughout the organization?
11.	What have you and your unit/clinic done so far to improve patient flow in your hospital?
12.	What changes would you like to see within your unit's/clinic's and the hospital's organization to enable a more effective flow of patients through the hospital?