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UNIVERSITÀ
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Dottorato di ricerca in Management & Innovation

Ciclo XXXVII

S.S.D: SECS P/07

The role of Operations Management in healthcare sector: evolution and implementation

Tesi di dottorato di: Rossella Pellegrino

Anno Accademico 2023/2024

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The role of Operations Management in healthcare sector: evolution and implementation

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Introduction

Operations Management (OM) is a managerial function defined by different authors in various ways, but it focuses on coordinating resources and processes efficiently. Chase *et al.* (2004) described OM as the process of designing, implementing and improving business systems for managing production, supply and overall control of operations. Reid and Sanders (2005) emphasized OM's role in planning, managing, and controlling resources for the production and delivery of goods and services, and Graham (2006) highlighted its central function in managing processes involved in the production and delivery of services. Schroeder (2007) added that OM aims to organize activities in a way that creates value and adapts its application to the specific needs of the organization. Calcagno (1996) defined OM as a series of activities that focus on efficient conversion of inputs into outputs and emphasize process control. In the health sector, OM has specific characteristics, including comprehensive monitoring of logistical flows such as the movement of goods and patients, as well as strategic planning and the management of processes that support the journey of patients. The main objective of the OM in healthcare is to ensure the effective coordination and optimal integration of logistics across different medical environments, thus facilitating both efficient and resource-conscious clinical care (Vissers *et al*. 2005; Fenech *et al.* 2018; Langabeer II & Helton 2020; Villa 2021).

In this framework, two major areas of OM in healthcare emerge: (i) supply chain management and (ii) patient flow management.

Supply chain management in healthcare is based on the effective management of key resources, such as medical supplies, equipment and medicines, which are essential to patient care. Strategic approaches in this area ensure the reliable availability of these resources, promote partnerships with suppliers and optimize costs. The integration of advanced technologies is increasingly crucial to improve supply chain efficiency and ensure high quality care.

On the other hand, the management of patient flows is aimed at optimizing the movement of patients within healthcare facilities, focusing on reducing waiting times and maximising resource use. This requires seamless communication between departments and continuous analysis of patient flow data to improve patient experience and health outcomes.

In recent years, the function of OM has played an important role in the healthcare sector, as health facilities are constantly needed to balance efficiency and effectiveness without compromising the quality of care offered. Additionally, this function has proven essential in addressing contemporary challenges within the sector, which have been further accentuated by the pandemic The main challenges include:

(i) the shortage of medical and nursing staff, which places pressure on healthcare systems globally;
(ii) demographic and social evolution, with an aging population and the increase in chronic diseases requiring continuous and complex management;
(iii) the rising healthcare expenditures necessitating innovative solutions for effective resource management;
(iv) technological and digital transformation, which offers both opportunities and challenges for the integration and adoption of innovations in clinical and administrative processes.

Despite significant advancements in the literature on Operations Management in healthcare, there are still considerable gaps regarding the effective implementation of flow management strategies to improve hospital efficiency and quality of care. Many healthcare facilities struggle to implement OM practices in a standardized and consistent manner, unlike the manufacturing and industrial sectors where OM originated and developed successfully. This lack of standardization and fragmentation limits healthcare facilities' ability to achieve the maximum benefits from OM practices, leaving room for significant improvements.

This thesis aims to shed light on the innovative managerial function of Operations Management in healthcare, providing both theoretical and practical contributions. Therefore, the thesis (summarized in Table 1) is structured as follows:

- the **first chapter** systematically analyses the healthcare Operations Management literature and examines its evolution from manufacturing to healthcare, focusing on the flow of patients. Through the analysis of literature and content, the aim is to explore current trends, challenges and future directions. The results contribute to the development of a theoretical framework for forecasting future trends in OM. Early research highlighted the strategic role of OM, resource organization, waste reduction, productivity, and resource management. The integration of lean, 6

Sigma and simulation modelling subsequently improved the overall operation of the hospital. Patient pathway analysis has evolved to provide a comprehensive understanding of health systems. Recent studies have highlighted the value of the patient, personalized medicine and patient profiling: technological innovation enables analysis of patient demand, grouping on the basis of profiles, and increasingly personalized and precise care;

- the **second chapter** examines the state of the art in the implementation of the OM in health facilities, as its spread has occurred in an imbalance and often follows current trends. The role of the OM is analysed as an innovative organizational and management function in terms of responsibilities, tools and approaches used, office composition, organizational position and training. To conduct the investigation, an ad hoc survey was created, composed of six sections with multiple choice questions and Likert scale questions (from 1-strongly disagree to 5-strongly agree). The sample includes public and private hospitals in the Lombardy region, which since 2016 has undergone a socio-health system reform with the introduction of an OM function;
- the **third chapter** can be considered an extension of the previous chapter as it uses the same samples and data from the survey. The results of the previous chapter show that the OM functions are not standardized and vary within organizations in terms of roles, functions, responsibilities, support for information systems and strategic planning. This chapter aims to identify factors or combinations of factors that, together with the presence of the OM office, can guarantee the expected results in terms of resource allocation, efficiency, and effectiveness, while also meeting the expected quality standards. Specifically, in this case, the term “factors” includes all those characteristics of the OM function that differentiate healthcare organizations (see Chapter 2). The study's results aim to provide a contribution guiding healthcare facilities toward effective implementation of the OM function by identifying favourable managerial and organizational conditions that enable these roles to perform their functions effectively. The methodology used is coincidence analysis, which allows qualitative data to be transformed into quantitative data and can be applied to small sample sizes;

- the **fourth chapter** aims to analyse the OM function in supporting the redesign of integrated care approaches for chronic patients, with a specific focus on patients with epilepsy. In line with the theoretical framework developed in the first chapter, the importance and necessity of analysing patient demand, needs, and expectations, and adjusting the service to meet their needs to improve perceived quality of care is recognized.

The findings of this study highlight the crucial role of OM, particularly within the healthcare sector, where it is significantly influenced by external factors such as epidemiological shifts and technological innovation. In this context, Italy exhibits considerable diversity and fragmentation, reflecting the decentralized nature of its healthcare system. Consequently, there is a need to establish guidelines to steer, guide, and standardize the implementation and evolution of this function. This effort aims to support the increasing demand and the more personalized and specific healthcare needs of the population.

Table 1- Summary of thesis

	First Chapter	Second Chapter	Third Chapter	Fourth Chapter
	Foundations to frontiers: charting the evolution of healthcare operations management and the patient journey	**Development trajectories of the operations management function in Italian healthcare organizations**	**Organizational structure and operations management conditions in Italian hospital settings: a case study**	**Integrated care and patient's satisfaction: evidence from the case of people with epilepsy**
Goals	1. What insights can be gained from a bibliomteric systematic literature review of OM within the health care sector, particularly regarding the growth and impact of publications, key authors and institutions, and emerging research themes? 2. How has OM evolved longitudinally within the healthcare sector, from its inception to its contemporary applications, and what are the key thematic shifts observed?	1. What are the most common and utilised tools and models in operations management? 2. What are the most significant perceived obstacles?	1. How are OM units organized and operate in hospital settings? 2. What combinations of OM conditions (or factors) are associated with enhancements in hospital operational efficiency?	1. How can we measure the concept of integrated care in the case of complex and chronic diseases such as epilepsy? 2. Is integrated care a feature of healthcare provision that is positively evaluated by patients?
Method	Systematic Literature Review with Biblioshiny (616 articles, timespan: 1991-2022)	Setting: Lombardy region Data collected by survey Descriptive analysis	CNA dataset 20 (cases) x 41 (variables)	Sample: 474 patients Data collected by survey Regression analysis to study the perceived integrated care approach as a predictor of personal satisfaction

1. Foundations to frontiers: charting the evolution of healthcare operations management and the patient journey[1]

Purpose: This study conducted a systematic analysis of key literature in healthcare Operations Management (OM), charting its progression from manufacturing to healthcare, by addressing the following questions: (i) what insights can be gained from a bibliometric systematic literature review of OM within the healthcare sector, particularly regarding the growth and impact of publications, key authors and institutions, and emerging research themes?; (ii) how has OM evolved longitudinally within the healthcare sector, from its inception to its contemporary applications, and what are the key thematic shifts observed?

Method: The study adopted a hybrid approach combining bibliometric and content analysis methods. Data from the Web of Science Core Collection™ were gathered, focusing on journals in Health Care Sciences Services, Management, and Operations Research Management Science, resulting in 604 English language original research papers for analysis.
The methodology involved several key steps. First, the authors analysed the chronological development of topics through the histograph method, informed by algorithmic historiography as introduced by Eugene Garfield. It effectively maps out citation distributions over time. This method is adept at identifying seminal papers and key authors, thus highlighting trends, progression, and clusters in the research field. Secondly, they implemented thematic evolution mapping to trace the trajectories of different research streams, positioning them within the life cycle of a topic. This approach is crucial for a more nuanced representation of research opportunities and the dynamic evolution of topics. Thirdly, thematic clusters identified through these methods were further explored using content analysis.

Results: The field of OM initially focused on strategic decision-making and resource organization, emphasizing productivity enhancement and efficiency within production units like outpatient departments and emergency rooms. As OM matured, practical applications of methodologies like Lean and Six Sigma emerged, emphasizing waste reduction and process optimization. This phase also saw the integration of simulation models, shifting towards practical implementation. Recent developments prioritize patient-centric care, leveraging big data and artificial intelligence for personalized medicine and patient profiling. This shift underscores the importance of forecasting patient demand and embracing technological advancements. The analysis has contributed to the development of a theoretical framework, highlighting implications for future research directions, healthcare managers, and policymakers.

Keywords: healthcare operations management, patient flow, bibliometrics

[1] Co-contributor: Prof. Stefano Villa

1.1 Introduction

In the ever-changing landscape of the healthcare sector, characterized by an aging population and rising costs, the importance of efficient and effective operations management (OM) has never been more apparent. Per capita healthcare spending has surged by over 70% since the early 1990s, reflecting a population that is progressively healthier and living longer (OECD, 2010). The growing aging population, now comprising 20.3% of the demographic (EUROSTAT, 2019), along with the prevalence of chronic diseases and multimorbidity, has resulted in a sharp increase in demand for healthcare services. At the same time, the costs associated with medical technology and equipment have risen, consuming an increasing share of healthcare budgets. Additionally, the sector faces a significant fiscal challenge as government spending on healthcare remains substantial. There is also a noticeable mismatch in the labour market, with a significant shortage of healthcare personnel despite heightened recruitment efforts from healthcare institutions (Langabeer II & Helton, 2020). This highlights the urgent need for a strategic overhaul in healthcare operations management to address the growing demand while effectively managing limited resources.

Amid these challenges, the role of Operations Management (OM) in healthcare has come to the forefront as a critical element in ensuring not only the quality-of-service delivery but also the optimization of resources. While OM's evolution in the manufacturing sector has been well-documented, transitioning from pragmatic problem-solving to a strategic integrator and a crucial driver for competitive advantage and value creation (Weelwright and Hayes, 1980), its trajectory in healthcare warrants a distinct examination. The healthcare sector's unique demands necessitate an approach that transcends mere economic restructuring, calling for an integration of efficiency and effectiveness to yield value for patients. The OM function in healthcare is pivotal in managing logistical flows, coordinating production processes, and ensuring the integration of logistics within various operational settings to foster an efficient and resource-effective clinical care process (Vissers *et al*., 2005; Langabeer II & Helton, 2020; Villa, 2021).

This paper aims to dissect and delineate the evolution of the OM function within the healthcare sector. Through an exhaustive bibliometric analysis, particularly focusing on patient flow, this study endeavours to elucidate the current state of OM in healthcare, distilling the scientific literature to unravel thematic clusters, delineate challenges, and

forecast future directions. By comprehending the trajectory of OM's development, this research aspires to offer a comprehensive perspective on its pivotal influence in shaping the modern healthcare landscape, thereby guiding future strategies and enhancing operational efficacy in healthcare services. The subsequent sections of this paper are meticulously structured to unfold this narrative, beginning with an exposition of the OM concept, followed by the methodology, the results, and a concluding discussion. This scholarly endeavour is not just an academic exercise but a crucial step towards empowering healthcare providers to navigate the complexities of modern healthcare delivery with strategic finesse and operational excellence.

The study is structured as follows. The first part of the paper is dedicated to presenting the evolution of OM in manufacturing and healthcare. This is followed by the methodology section, then the presentation of results, a discussion, and finally, the conclusion along with implications, strengths and limitations.

1.2 Background: Operations Management in manufacturing and healthcare

1.2.1 Manufacturing Sector

The progression of OM from the Industrial Revolution to the contemporary era marks substantial advancements in production methodologies, technological innovations, and strategic paradigms. Initiated in the 1700s, mass production, catalysed by Adam Smith's division of labour concept, transformed manufacturing by promoting efficiency and productivity through task specialization.

Eli Whitney's introduction of interchangeable parts in 1799 streamlined mass production, fostering predictability and cost control, thereby laying the foundation for modern cost accounting principles (Nelson, 1982).

Between the nineteenth and twentieth centuries, the first true school of managerial thought emerged in the United States, known as "Scientific Management", with Frederick Taylor. He developed a systematic approach to operations management through scientific observation of production processes. His contribution emphasized the importance of standardizing tasks and procedures to enhance efficiency (Taylor, 1911). Scientific management also entailed rigorous operational control, from monitoring to correcting inefficiencies, and the selection of skilled employees based on their abilities to perform tasks.

Elton Mayo's human relations theory in the early 20th century emphasized the significance of social dynamics in workplace performance, steering OM towards a more holistic understanding of employee engagement (Mayo, 1933).

In the 1970s, the work of Wickham Skinner represented another crucial step in the evolution of operations management. Moving beyond the functional approach to production, he suggested revisiting production decisions considering corporate strategy mediated by production strategy (Skinner, 1969).

The 1980s witnessed the widespread acknowledgment of OM as a pivotal organizational function, spurred by escalating competition and the imperative to enhance manufacturing and service operations while curtailing costs (Filippini, 1997). Concepts such as Total Quality Management (TQM), Just in Time (JIT) systems, and Material Requirements Planning (MRP) gained prominence, pivoting the focus towards quality and efficiency (Heizer and Render, 2006).

In the 1990s, concerted efforts were made to amalgamate the two predominant production models, industrial and handcrafted, into a new approach termed neo-industrial production. This innovative method harmonized standardization with customization, ensuring both variety and customer satisfaction (Lanza, 1992). Neo-industrial production underscored understanding the value creation process for the customer, embracing JIT and lean thinking principles, and fostering effective communication and knowledge dissemination. Traditional factories underwent metamorphosis, adopting production models grounded in scientific principles, mechanization, and economies of scale to deliver personalized and adaptable performance (Hollingsworth, 2000).

From the 2000s, with the onset of the third phase of globalization, there emerged a shift towards mass customization, propelled by the necessity to cater to the diverse needs of a globalized market. This transition was facilitated by technological advancements, particularly the proliferation of the Internet, which provided unprecedented connectivity and accessibility (Heizer and Render, 2006).

The modern era has witnessed the ascent of the fourth industrial revolution (2011), characterized by artificial intelligence (AI), machine learning, big data, and the Internet of Things (IoT). These technologies enable large-scale data analysis, event simulation, and future forecasting based on historical data (Schwab, 2017). This shift has transitioned from the focused factory model to the smart factory, integrating various digital

technologies within a factory to create flexible and self-adaptive production capabilities, enhancing operational efficiency and flexibility (Hozdić, 2015; Kalsoom *et al*., 2020). These smart factories are integral components of the supply chain network, necessitating intense coordination and alignment among supply chain functions, converging towards an integrated value chain model. However, achieving this requires a long-term strategic plan aligned with objectives and a comprehensive digital transformation program, including a factory transformation plan.

This historical perspective aligns with the three phases of OM development outlined by Weelwright and Hayes (1980): (i) initially pragmatic (cost control), evolving into a (ii) strategically integrated function within business operations (mass customization), and (iii) currently indispensable for competitive advantage and value creation (from mass customization to customization and global market).

In conclusion, operations management in industry has evolved through standardization, quality control, process optimization, and digital transformation, increasingly crucial for resource management, production efficiency, and customer satisfaction. Its ongoing development remains imperative for companies to uphold a competitive edge in a dynamic environment.

1.2.2 Operations Management in the Healthcare Sector

In the healthcare sector, Operations Management (OM) encompasses the management of logistical flows, including goods and patients, alongside the planning and control of all production processes supporting healthcare pathways. The objective is to ensure coordination and maximum integration of logistics across various settings, thereby facilitating an effective and resource-efficient clinical care process (Vissers *et al*., 2005; Fenech *et al*., 2018; Langabeer II & Helton, 2020; Villa, 2021).

So, there are two principal domains of OM in healthcare sector: (i) supply chain management; (ii) patient flow, which will be analysed in detail in this study as objective of the literature review.

Supply chain management within the healthcare sector is aimed at managing important resources for care, including supplies, equipment and medications. A strategic approach to supply chain management ensures the consistent availability of these essential resources, cultivates strong relationships with suppliers and effectively optimizes costs. In addition, the integration of advanced technologies is essential to improve supply chain

efficiency and ultimately to ensure the provision of high-quality health services. On the other hand, patient flow management aims to optimize the patient journey within health facilities, focusing on minimizing waiting times and maximizing resource use. Effective management of patient flow requires seamless communication between departments and continuous data analysis, which together contribute to improved patient experience.

The integration of OM into the healthcare sector emerged in response to challenges faced by hospital facilities since the 1990s, primarily driven by increasing resource scarcity and the imperative of cost containment. These challenges were particularly evident in issues such as the availability of hospital beds and overcrowding in emergency departments (EDs) (Derlet and Richards, 2000; Derlet *et al*., 2001; Green and Nguyen, 2001).

Experts in the field-initiated efforts to develop frameworks and methodologies to support production planning and scheduling within hospital facilities. These early endeavours aimed to implement sophisticated analysis tools to optimize resource utilization and enhance the efficiency of internal processes, with a particular focus on individual production units such as EDs and operating rooms (Bagust *et al*., 1999; Jun *et al*., 1999).

However, it became evident that mere cost control and resource allocation were insufficient strategies for effective healthcare management. Reactive measures like cost control addressed scarcity only when it became apparent, whereas truly efficient management should be preventive, ensuring economic, social, and sustainable healthcare delivery without imposing undue restrictions. In this context, efficiency becomes preventive, emphasizing the improvement of care quality over mere cost control.

Moreover, it was recognized that process efficiency alone was not adequate. Effectiveness, measured by outcomes such as extending average life expectancy and improving quality of life, became paramount. Studies demonstrated the shift towards effectiveness-oriented strategies, alongside efficiency-focused measures. For instance, Chalfin and colleagues (2007) illustrated how timely patient transfers from the emergency department reduced hospital stays and mortality rates, while Bruin and colleagues (2007) analysed patient flow dynamics and its impact on overall hospital operations.

This integrated approach underscored the importance of informed and strategic decision-making considering the interconnections between various hospital areas and processes. Such an approach was deemed essential for effective resource management and significant enhancements in the overall patient experience.

Research on Operations Management (OM) has extensively traced its evolution in the industrial sector, spanning from its origins in the Industrial Revolution to its contemporary applications amidst the era of digital transformation. Similarly, the incorporation of OM into the healthcare sector has received significant attention, particularly regarding its role in enhancing efficiency and managing resources effectively. However, a research gap persists in thoroughly examining the longitudinal evolution of OM within healthcare, including its thematic shifts. While individual studies have explored specific facets of OM's progression, there exists a lack of comprehensive analysis, particularly through bibliometric systematic literature review methodologies. Consequently, there is a pressing need to bridge this gap by conducting a comprehensive longitudinal analysis that encompasses the healthcare sector, elucidating the thematic evolution of OM. This endeavour will pave the way for a deeper understanding of its applications and implications in modern healthcare contexts. Given the identified research gap, the following research questions are implicated:

1. What insights can be gained from a bibliometric systematic literature review of OM within the healthcare sector, particularly regarding the growth and impact of publications, key authors and institutions, and emerging research themes?
2. How has OM evolved longitudinally within the healthcare sector, from its inception to its contemporary applications, and what are the key thematic shifts observed.

1.3 Method

The theoretical review utilizes bibliometrics to thoroughly integrate and enhance conceptual and empirical research, aiming to refine and broaden theoretical frameworks and hypotheses (Parè *et al*., 2015). This approach effectively targets both emergent and mature research fields, pinpointing and addressing gaps in theoretical understanding. We adopt structured data science techniques to identify diverse research streams, revealing underlying patterns and encouraging the development of novel theories. The review begins with broad inquiries, refined through systematic literature collection and rigorous content analysis. Bibliometrics strengthens this review, ensuring a transparent, detailed

examination of extensive metadata, enhancing the robustness and depth of the theoretical insights.

1.3.1 Data Collection

Data were gathered from the Web of Science Core Collection™, a comprehensive repository known for its extensive coverage of scientific literature. The Web of Science (WoS) database is widely recognized as the premier generalist repository in bibliometric studies, especially within the managerial domain (Zupic, Cater, 2015; Booth *et al*. 2016). Its prominence is attributed to its comprehensive coverage and the high quality of its data (Visser *et al*., 2021), which minimizes the need for extensive data cleaning processes. Furthermore, the value of WoS is augmented by its meticulous data curation practices, especially evident in the management of cited references within each bibliographic record. This meticulous approach makes WoS an indispensable tool for conducting in-depth bibliometric analyses and thematic modelling.

To extract relevant data, an advanced search was performed using the 'topic' field, a method that ensures a thorough examination across titles, abstracts, and keywords of publications. This approach is consistent with methodologies employed in numerous bibliographic studies (Thananusak, 2019; Mendoza-Muñoz *et al*. 2022). The data compilation was finalized on 13 November 2023, a detail of significance considering the dynamic nature of the database, which undergoes continual updates (Liu *et al*. 2015).

The search strategy was precisely defined, employing the search equation (TS=("patient* flow*") OR TS=("patient* logistic*")), specifically tailored to capture publications relevant to the study's focus. The authors exclusively opted for the combination of these two terms for two main reasons: (i) during the initial phase, the use of overly specific terms, such as "operation* management," resulted in the exclusion of potentially relevant articles on patient flow, particularly within the healthcare context; (ii) the OM function encompasses two main areas (supply chain and patient flow), and, as outlined in the introduction, this study primarily focuses on the patient flow domain.

To ensure a targeted and relevant dataset, the search was restricted to journals categorized under three specific Web of Science subcategories: (i) Health Care Sciences Services, (ii) Management, and (iii) Operations Research Management Science. This selection was strategically made to encompass the fields and research areas pertinent to Operations Management and, more specifically, to the study of patient flow.

1.3.1.2 Inclusion and exclusion criteria

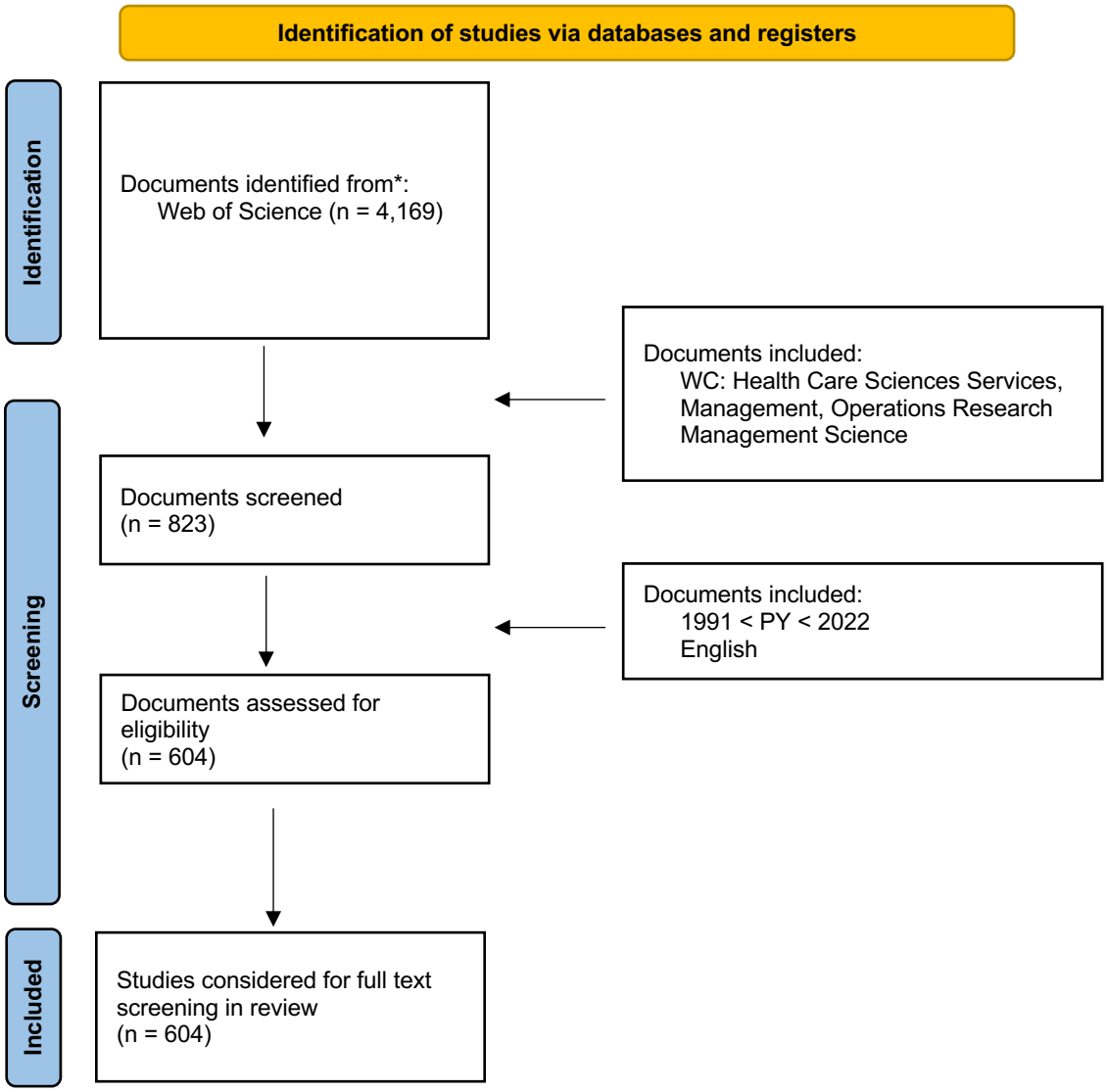
The screening and selection of articles adhered to the rigorous guidelines set forth by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework (Page *et al*., 2020), as depicted in Figure 1. The initial identification phase yielded a total of 4,169 research articles. To maintain a focus on high-quality, original research, the study was limited to English-language research articles, thereby excluding other document types such as editorials, reviews, book reviews, conference abstracts, and editorial pieces. Furthermore, to accurately capture the development of patient flow over time, the study was confined to a 30-year period, spanning from 1991 to 2022. Following a meticulous review, categorization, and analysis process, a final cohort of 604 articles was established as the basis for this research.

In conclusion, the main inclusion and exclusion criteria established and applied by the authors are as follows:

- publication years (from 1991 to 2022) to capture the evolution and implementation of patient flow over time;
- document types (only research articles), excluding other document types such as editorials, reviews, book reviews, conference abstracts, and editorial pieces;
- research fields (Categories): (i) Health Care Sciences and Services, (ii) Management, and (iii) Operations Research and Management Science;
- language (English).

Finally, one of the authors conducted a preliminary screening and analysis of the articles based on their titles, followed by an assessment of the abstracts.

Figure 1- PRISMA Flowchart of the literature review and selection process



1.3.2 Data analysis

The review leverages bibliometrics as a quantitative tool for science mapping, utilizing the open-source Bibliometrix R-package (Aria and Cuccurullo, 2017), and its web-app for non-coders, Biblioshiny. Recognized for their widespread use, comprehensiveness, and user-friendly nature (Munoz *et al*., 2020), these tools distinguish themselves by offering a broad spectrum of analytical and graphical options. This rich feature set ensures

that Bibliometrix transcends the limitations of a 'black box' tool, providing not only visual support but also a diverse array of metrics essential for a nuanced interpretation and presentation of the data.

Bibliometrics offers a distinct advantage in this context, enabling a transparent and rigorous review of large volumes of metadata. This facilitates a structured approach to content analysis.

This analysis commenced with a descriptive assessment of the document sample, focusing on the growth rate of publications related to the research theme over the last two decades. The investigation proceeded by evaluating the sample across three dimensions of scientific impact: (i) analysis of venues to identify and acknowledge key influential sources in the field; (ii) examination of authors to distinguish between prolific and occasional contributors, and to assess their dedication to the research theme by analysing their publication record and active life over time; and (iii) scrutiny of documents to evaluate their citation impact, both on a global and local scale, and to pinpoint seminal works.

Beyond the initial characterization of the sample, bibliometrics facilitated the extraction of the conceptual structure underlying the body of research. This was achieved by creating a thematic map on keyword plus and tracing the evolution of themes within the field. This integrative approach synthesizes and consolidates research findings into a coherent framework, offering an overarching perspective of the thematic landscape and its evolution over time. Dynamic thematic analysis thus serves as a foundation for the subsequent content analysis, aiming not only to map the research trajectory but also to spotlight key trends, thereby enriching the understanding of the dynamic nature of the field and provides valuable insights into its progress.

1.4 Results

1.4.1 Descriptive analysis and sample overview

The search yielded a rich collection of 604 articles spanning 172 journals across three subcategories: Health Care Sciences Services, Management, and Operations Research Management Science. This corpus, authored by 2,502 contributors, reflects a significant international collaboration, evident from an 18.21% co-authorship rate. The articles, on average, received 16.22 citations, highlighting their impact within the academic

community. The research depth is further evidenced by the identification of 1,063 keywords and 1,635 author keywords, detailed in Table 1.

Table 1- Main information about data

Main information about data	
Timespan	1991:2022
Sources	172
Documents	604
Annual Growth Rate %	15.14
Average citation per doc	16.22
References	17,546
Document contents	
Keywords Plus (ID)	1,063
Author's Keyword (DE)	1,635
Authors	
Authors	2,502
Authors of single-authored docs	18
Authors collaborations	
Single-authored docs	22
Co-Authors per Doc	4.63
International co-authorships %	18.21

A notable trend is the steady annual growth in publications, with a rate of 15.14%, particularly since 2009 (Fig.2). The initial two decades (1991-2012) saw a modest publication frequency, generally not exceeding 12 articles per year. However, the last decade (2013-2022) marked a significant uptick in output, peaking in 2022 with 79 publications, constituting 13.08% of the total.

The analysis of journal sources, guided by Bradford's Law, resulted in three clusters based on citation frequency and publication volume. The most cited cluster included 10 journals with 205 articles, demonstrating the journals' centrality in the field. Figure 3 charts the output of the top ten journals, with BMC Health Services Research leading in productivity. The journals are ranked based on citation impact and publication volume, with BMC Health Services Research consistently leading across various indices.

The whole selected sample amasses 17,546 unique citations. The top 25 most cited documents, predominantly from the second decade (2002-2012), represent 25.52% of

total citations. Brailsford *et al*. (2004) emerged as the most global cited work, with subsequent papers focusing on enhancing productive capacity through patient flow mapping and process optimization, primarily in hospital settings. Locally cited documents, which reflect citations within the dataset, spotlighted works by Gunal and Pidd (2009), Hoot and Aronsky (2008), and Jun *et al*. (1999), focusing on resource allocation and patient flow in hospital settings.

Figure 2- Annual Scientific Production

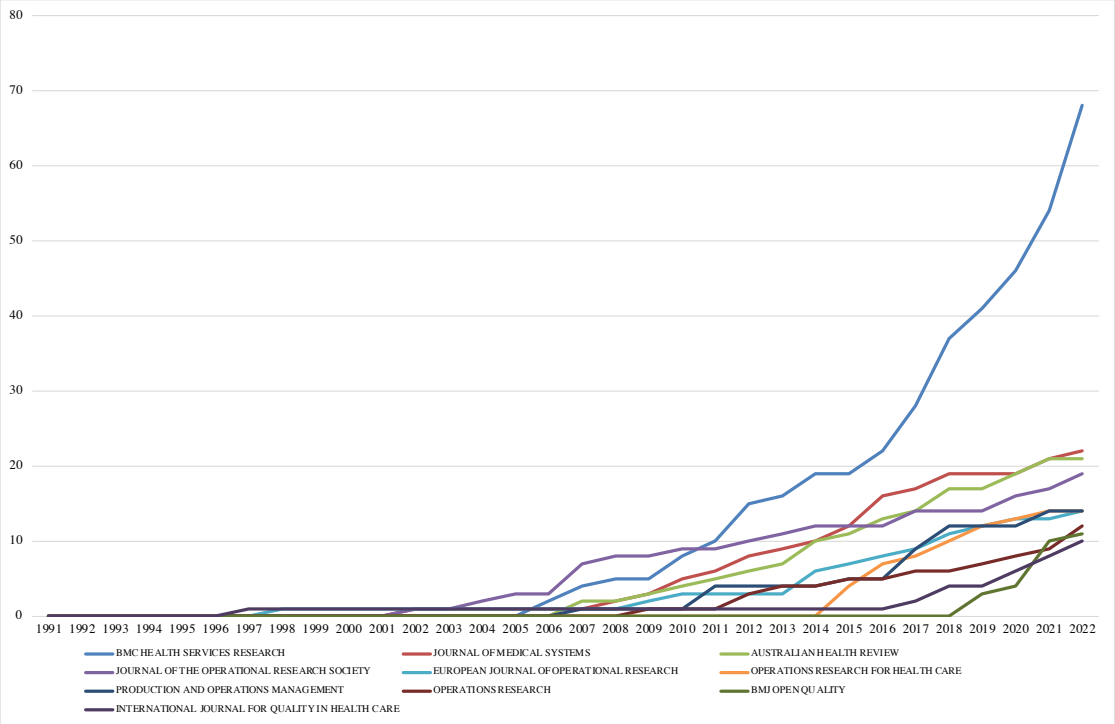
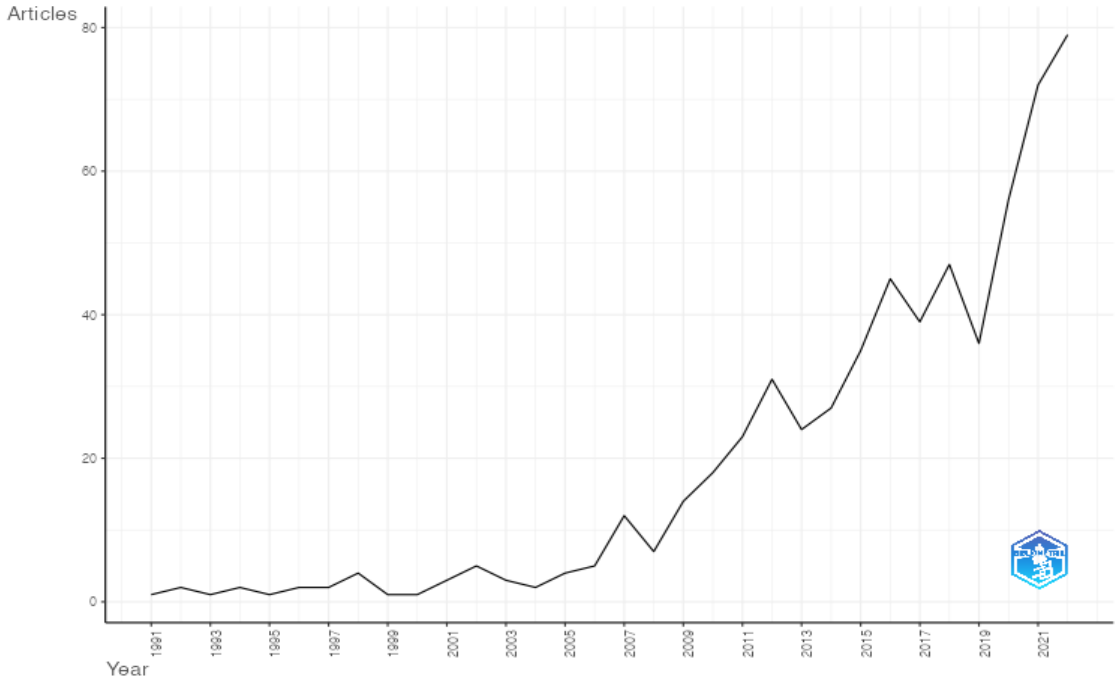


Figure 3- Sources' Production over time



Note: The chart represents the production over the years of the 10 journals included in Zone 1, according to Bradford's Law.

1.4.2 Longitudinal analysis

PEAKS Reference Publication Year Spectroscopy (RPYS) analysis revealed influential years and themes in the dataset's citations. The first decade (1991-2001) recorded initial challenges in hospital resource management, while the second decade (2002-2012) concentrated on optimizing hospital performance and operational efficiency. The third decade (2013-2022) emphasized patient-centric approaches and the application of operations management tools, underscoring a maturity in the field and a push towards leveraging advanced technological tools for future scenario simulation and patient demand analysis.

1.4.3 Knowledge Structure

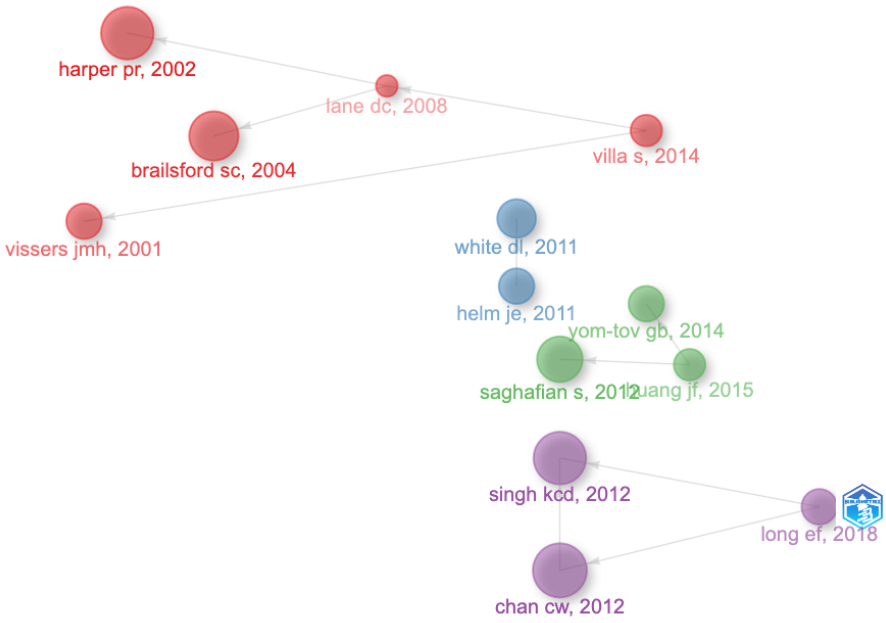
1.4.3.1 Research Streams (Historiographic Mapping)

Historiographic mapping is a bibliometric technique for tracing the historical trajectory of a research topic, pinpointing pivotal authors, and seminal documents. It's instrumental in discerning paradigm shifts and intellectual schools of thought by performing a direct citation analysis over time (Garfield, 2004). Specifically, Figure 4 presents a network of

the top 13 references that have significantly influenced the historical development of the patient flow approach in healthcare. Four primary research streams emerge:

1. red stream focuses on Production, Efficiency, and Resource Optimization, proposing a hierarchical framework for hospital production that balances service provision with operational efficiency through multi-level planning (Visser *et al.*, 2001; Villa *et al.,* 2014) while simultaneously addressing the maximization or minimization of objective functions within individual production units using sophisticated tools (Harper and Shahani, 2002; Brailsford *et al.*, 2014; Lane and Husemann, 2008);
2. blue stream highlights the patient flow approach's role in strategic decision-making, resource management, patient safety enhancement (Helm *et al.*, 2011, White *et al.*, 2011);
3. green and purple streams emphasize Specific Hospital Settings (Emergency Department and Intensive Care Units). It reveals a transition from theoretical framework development to practical application, employing quantitative tools and systemic resource allocation approaches. This stream recognizes both economic and clinical benefits, with strategies to reduce readmissions and enhance hospital capacities.

Figure 4- Historiographic Mapping



1.4.3.2 Topic Life cycle (Thematic Map and Evolution)

The thematic map, rooted in co-word network analysis and clustering, visualizes the typological themes of a domain on a two-dimensional map (Cobo *et al*., 2011). The x-axis denotes topic relevance (Callon's centrality), and the y-axis represents topic development (Callon's density), categorizing topics into four quadrants:

1. motor themes: well-developed and crucial for structuring the domain's conceptual framework;
2. basic themes: significant across different domain areas but less developed;
3. peripheral topics: either emerging or declining, not fully developed or marginally interesting;
4. niche topics: highly developed but still marginal within the framework.

Figures 5a-c illustrate the thematic map of scientific production, dissected across three decades to discern emergent themes, their evolution, and consolidation. The thematic trend aligns with the publication trend (Figure 2), indicating that a higher number of publications correlate with more major themes identified.

In the initial decade, the thematic map shows OM expanding from manufacturing to service production. This embryonic phase focuses on addressing resource scarcity to enhance utilization. Key emerging themes include "hospital utilization," "determinants," and "service," all linked to improving efficiency (Figure 5a).

The second and third decades mark a shift in focus. The evolution of OM now emphasizes themes like effectiveness and quality, transitioning these from emerging concepts to central, cross-domain themes (Figures 5b and 5c). This period reflects a change from viewing healthcare units in isolation to a more systemic, dynamic approach. Over the recent decade, the focus in research has shifted towards the implementation and adoption of lean production methodologies like Lean Thinking, Six-Sigma, and Discrete Event Simulation for waste reduction and improvement, becoming primary and significant themes (Figure 5c). Concurrently, the main research drivers in this field have been the classification and profiling of patients, aimed at reducing hospital readmissions, and the optimization of resource allocation to meet growing demands, highlighted by keywords such as “prediction,” “classification,” “readmission,” “algorithm,” and “demand” (Figure 5c). Despite the onset of the fourth industrial revolution, the area of telemedicine has remained a relatively specialized topic (Figure 5c).

Chang and colleagues (2020) employed the Six Sigma method to examine the improvement of temporal efficiency in operating rooms, reducing process variations. Alowad and colleagues (2020), on the other hand, utilized other lean tools such as process mapping and A3 problem-solving sheets. These tools, combined with patient expectations, allowed them to achieve the following objectives: (i) identify the root causes of long patient waiting times in the Emergency Department (ED), (ii) improve patient flow and the productive capacity of the ED, considering patient perception and satisfaction. The contribution of Demirli and colleagues (2021) is also significant. Taking into account the variability to which patient flow is subject, they combined lean tools with discrete-event simulation. This enabled the verification of solutions under dynamic conditions, helping to plan arrivals and strike a balance with waiting times.

On the other hand, Schiro and colleagues (2020) developed a patient prioritization tool. This interface should meet the needs of physicians and nurses, represent patient care stages, and include patient information such as waiting time, test status (e.g., prescribed, in progress), age, and a prioritization suggestion. The developed mock-up displays the status of patients progressing through the emergency department; a strip represents the patient and their characteristics, including a delay indicator that compares the patient's waiting time to the average waiting time of patients with a comparable emergency reason. The analysis of strategic map also reveals that the emergency department remains a central focus of academic interest across various healthcare production settings (Figures 5b and 5c). Over the years, scholars have continued to prioritize the emergency department because, as the primary point of access to the healthcare system, its effective management is crucial for optimizing resource allocation—such as beds and personnel—across other hospital departments.

Arora and colleagues (2023) revisited the issue of emergency department overcrowding. Through personalized probabilistic forecasts, they provide low-acuity patients and first responders with a more comprehensive view of potential emergency department waiting times. Such information would help patients and ambulance staff choose a less crowded and more appropriate emergency department within an emergency department area, resulting in a more evenly distributed patient load across the network.

Despite the advent of the fourth industrial revolution, telemedicine still is a niche topic. Telemedicine (Figure 5c), whose advent and implementation have intensified during the

COVID-19 pandemic, aims to improve patient flow, prevent hospital readmissions and exacerbations of chronic conditions, reducing distances and thereby ensuring a degree of equity in access to care regardless of geographic location (Uddin *et al*., 2015; Keogh *et al*., 2016; Shima *et al*., 2022). The field continues to evolve, with quality improvement gaining centrality, underscoring the importance of proper planning and resource allocation based on patient flow analysis for cost containment and achieving high-quality standards.

Over the past three decades, there has been a growing recognition of the importance of quality in the healthcare sector (see Figures 5a-c). Initially considered an emerging issue (first decade 1991-2001, see Fig. 5a), quality has now become a fundamental and indispensable pillar (2002-2022, see Figures 5b-c). This development reflects the peculiarities of the sector, where it is necessary to reach and identify the right trade-off between efficiency and effectiveness (understood as the quality of care provided). The quality of care includes patient safety, adherence to clinical guidelines, timely access to healthcare services, and customization of care based on individual needs. These elements are essential to ensure patient satisfaction and achieve optimal clinical outcomes. Patient satisfaction may be considered as a fundamental indicator of the quality of care, reflecting patients' perceptions of the care received. Satisfied patients are more likely to follow medical advice, adhere to prescribed treatments, and maintain a positive relationship with the healthcare system.

Figure 5a – Thematic Map (1991-2001)

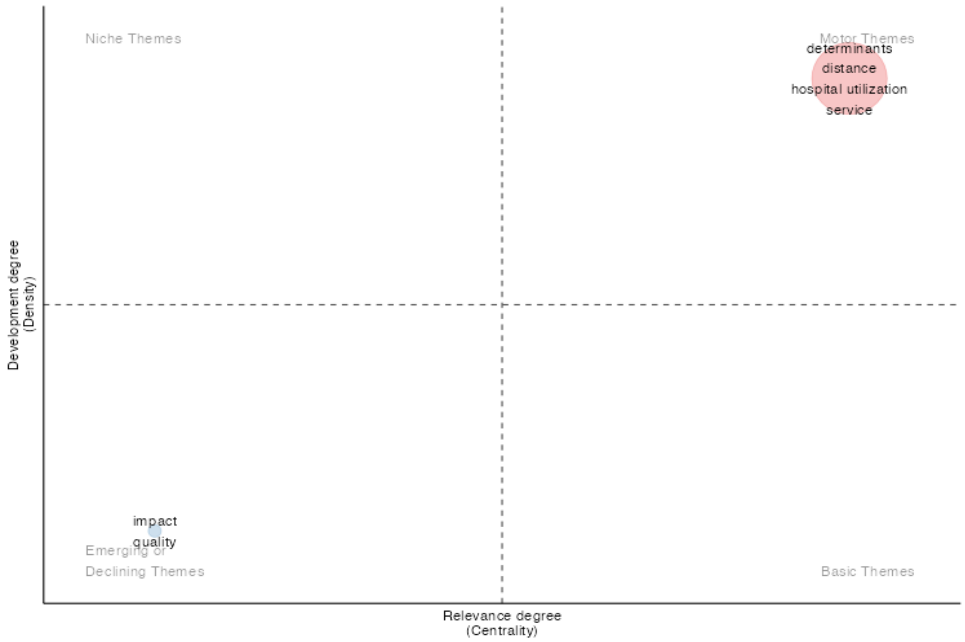


Figure 5b – Thematic Map (2002-2012)

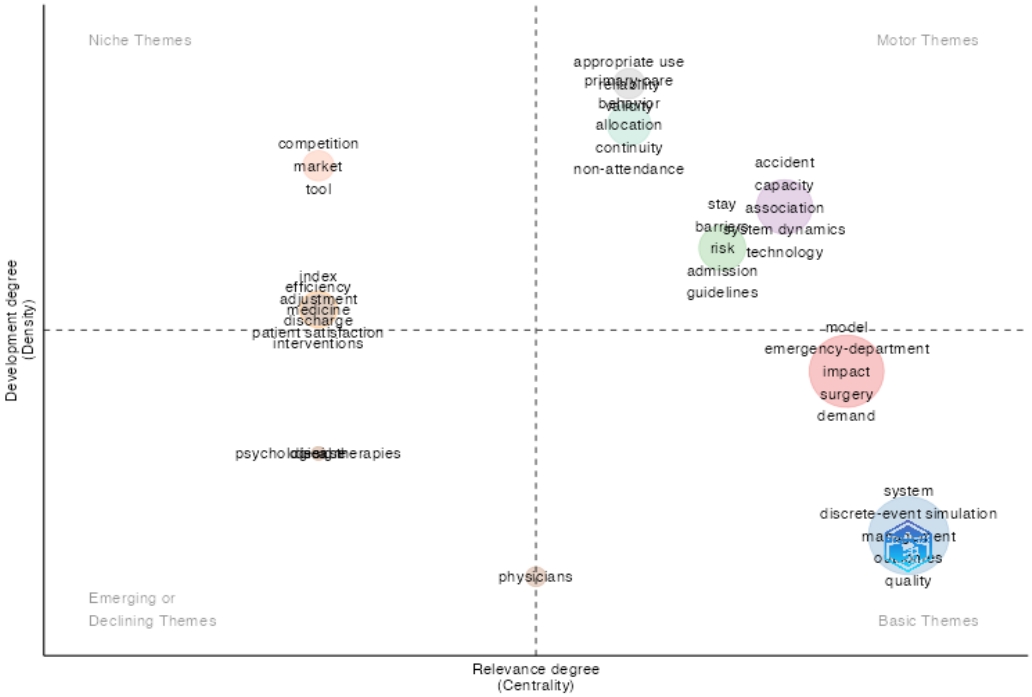
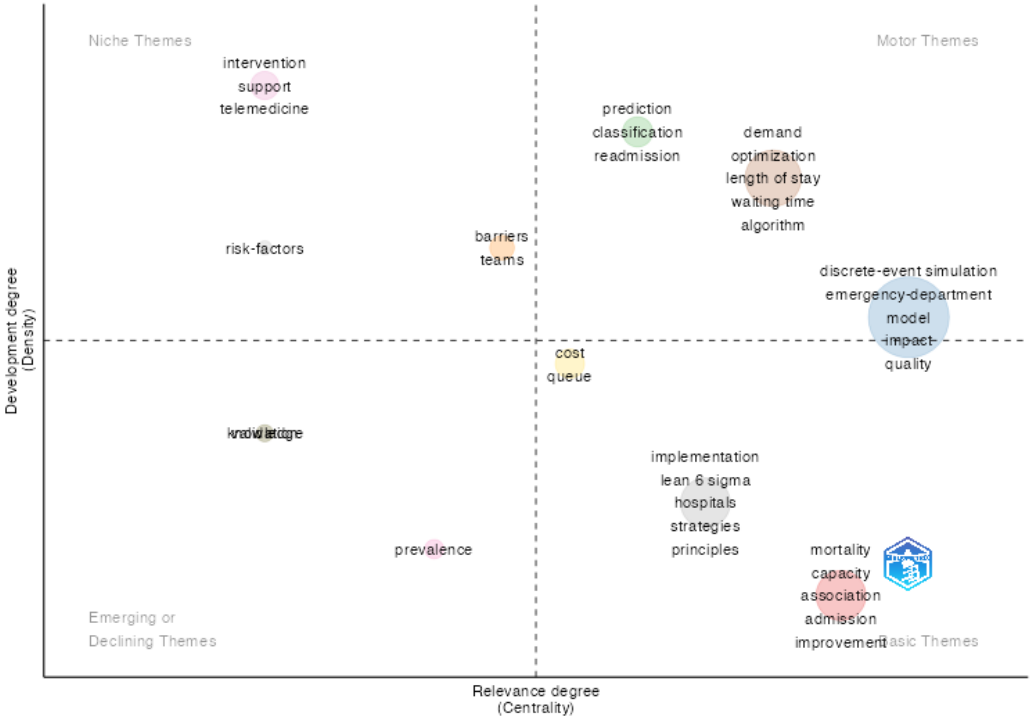


Figure 5c – Thematic map (2003-2022)



1.5 Discussions

Our study reviews and analyses the evolution of Operations Management in healthcare, with a particular emphasis on patient flow. The results, synthesized in Figure 6, outline a framework that traces the progression of OM from its initial focus on strategic decision support and resource management to its current role in enhancing patient-centric care through advanced technological tools.

Initially, the healthcare literature emphasized OM's role in addressing the pressing need for strategic decision-making and efficient resource management. At this stage, healthcare organizations grappled with resource scarcity, prompting the development of sophisticated capacity planning models and decision support systems. These early efforts primarily focused on improving the efficiency of individual healthcare units, such as outpatient departments, emergency rooms, and operating rooms. OM strategies aimed to streamline processes, reduce waiting times, and ensure optimal resource utilization to meet growing patient demand.

As the healthcare landscape evolved, there emerged a notable shift towards adopting industrial OM methodologies, notably Lean and Six Sigma. Lean methodology, inspired by principles from manufacturing, emphasizes the elimination of waste and the optimization of workflow. Six Sigma, on the other hand, focuses on data-driven problem-solving and quality improvement through rigorous statistical analysis. The integration of these methodologies into healthcare operations marked a significant paradigm shift, moving from theoretical frameworks to practical applications. Healthcare organizations began implementing Lean and Six Sigma principles to streamline processes, reduce errors, and enhance overall quality of care. Chang and colleagues (2020) utilized the Six Sigma method to improve temporal efficiency in operating rooms, reducing process variations, while Alowad and colleagues (2020) applied lean tools like process mapping and A3 problem-solving to reduce waiting times and improve patient flow in the ED.

Furthermore, the advent of advanced technologies such as simulation modelling and predictive analytics enabled healthcare practitioners to anticipate and address patient flow challenges more effectively. By simulating various scenarios and analysing historical data, healthcare organizations could identify bottlenecks, optimize resource allocation,

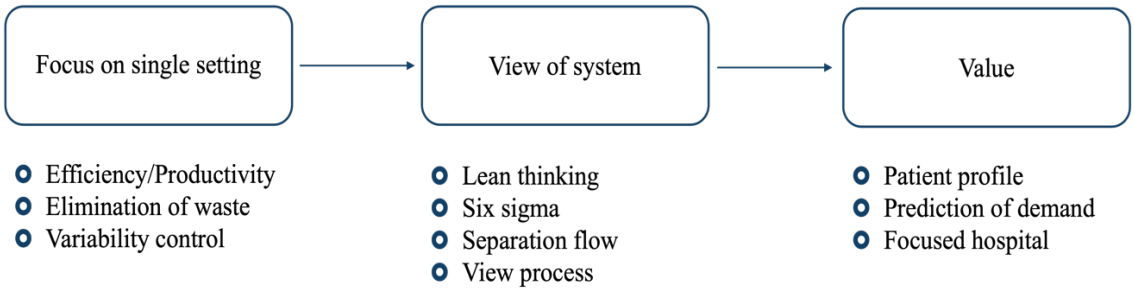
and improve patient outcomes. Demirli and colleagues (2021) combined lean tools with discrete-event simulation to account for variability in patient flow, enabling dynamic testing of solutions under different conditions to improve resource allocation and waiting times. Simulation models allowed for the testing of different operational strategies, facilitating evidence-based decision-making and continuous process improvement.

In recent years, there has been a growing emphasis on patient-centred care and personalized medicine within the OM framework. Healthcare organizations are increasingly recognizing the importance of tailoring treatment plans and interventions to individual patient needs and preferences. This shift towards patient-centric care has been facilitated by advancements in big data analytics, artificial intelligence, and genomics. By leveraging these technologies, healthcare providers can analyse vast amounts of patient data to identify patterns, predict outcomes, and personalize treatment approaches.

Moreover, the emergence of focused hospitals and specialized care units reflects a broader trend towards delivering targeted, high-quality care to specific patient populations. Schiro and colleagues (2020), for instance, developed a patient prioritization tool to optimize care delivery in the ED by considering patient characteristics, waiting times, and clinical status. These specialized facilities are designed to meet the unique needs of patients with complex medical conditions or specialized care requirements. By concentrating resources and expertise in specific areas, focused hospitals can achieve economies of scale, improve clinical outcomes, and enhance patient satisfaction.

Overall, the evolution of OM in healthcare has been characterized by a shift towards greater efficiency, quality, and patient-centredness. By leveraging industrial methodologies, advanced technologies, and personalized approaches, healthcare organizations can optimize patient flow, improve resource utilization, and deliver higher-quality care to patients. This ongoing evolution underscores the importance of OM in driving continuous improvement and innovation within the healthcare sector.

Figure 6- Evolution of OM role



1.6 Strengths and limitations

Although the bibliometric analysis related to the evolution of Operations Management, with a particular focus on the area of *patient flow*, has yielded some interesting results, it is essential to recognize both the strengths and limitations of this study.

Firstly, it would have been beneficial to extend the search to additional databases, although this could have risked incomplete information about the articles, thereby limiting the possibility of conducting a comprehensive bibliometric analysis. Furthermore, only articles published in scientific journals were included. No specific search was conducted for doctoral theses (available, for instance, through ProQuest) or books. This decision was made because relevant doctoral thesis results are typically published in peer-reviewed journals. Therefore, peer-reviewed articles are the most appropriate source for keyword analysis, as books and book chapters often do not include such metadata.

Another important choice concerns the time frame considered: only articles published up to 2022 were included to ensure a sufficiently broad time window, while also incorporating more recent studies that highlight emerging research trends. However, the title and abstract screening process could have benefited from broader author involvement to enhance the robustness and overall validity of the study.

1.7 Conclusions and implications

The insights derived from the research emphasize the critical role of integrating advanced operational models, such as Lean and Six Sigma, into the management of patient flows to enhance efficiency within healthcare settings. These models, rooted in principles of waste reduction, process optimization, and continuous improvement, have proven effective in addressing pressing challenges in healthcare, including bed shortages, waiting lists, and overcrowding in emergency departments. The theoretical contribution of this study highlights that the application of these operational techniques, which have been successful in manufacturing and other industries, can provide pragmatic solutions to critical issues within hospitals and clinics.

However, as the study underscores, while operational models such as Lean and Six Sigma can enhance the efficiency of individual units, a more comprehensive, system-wide approach is required to ensure sustainable improvements across healthcare organizations. The growing complexity of patient care, driven by factors such as an aging population, comorbidities, and chronic conditions, demands an approach that extends beyond the optimization of isolated units. To this end, scholars should explore the application of simulation models and decision-making tools that account for variability in patient flows throughout the entire healthcare system. These models can assist healthcare managers in predicting demand, optimizing resource allocation, and designing personalized care pathways tailored to individual patient profiles.

The study also highlights the importance of integrating emerging technologies, such as artificial intelligence (AI) and big data analytics, to enhance these advanced operational models. By leveraging AI, healthcare organizations can gain deeper insights into patient behaviors, predict future trends, and automate routine tasks, thereby improving operational efficiency. Big data, in turn, enables real-time monitoring of patient conditions, which enhances decision-making and resource allocation. These technologies can strengthen the precision of operations management models, enabling healthcare organizations not only to improve efficiency but also to customize care to meet the diverse needs of patients.

From a policy perspective, the study stresses the necessity of creating an environment that encourages the adoption of these technologies and operational models. Policymakers should prioritize initiatives that promote innovation, invest in training healthcare professionals, and facilitate the integration of new technologies into healthcare systems.

In particular, policies that encourage the development of interoperable systems, allowing for seamless sharing of patient data and treatment information across different units and institutions, will be pivotal in optimizing patient flows and resource allocation within healthcare networks.

In conclusion, this study contributes to the theoretical understanding of operations management in healthcare by illustrating how advanced models such as Lean and Six Sigma, in conjunction with technologies like AI and big data, can transform healthcare operations. Scholars are encouraged to further investigate the use of simulation and decision-making models to address inherent variability in healthcare systems and to design personalized care pathways. Policymakers, in turn, should foster the adoption of these innovations by creating conducive conditions for technological integration, ultimately supporting the development of a flexible, responsive healthcare system capable of meeting the evolving needs of patients.

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1.9 Supplementary materials

Source Analysis (a) Source local impact by H-index; (b) Most relevant sources; (c) Source local impact by G—index; (d) Source local impact by total citations (TC) index; (e) Most local cited sources.

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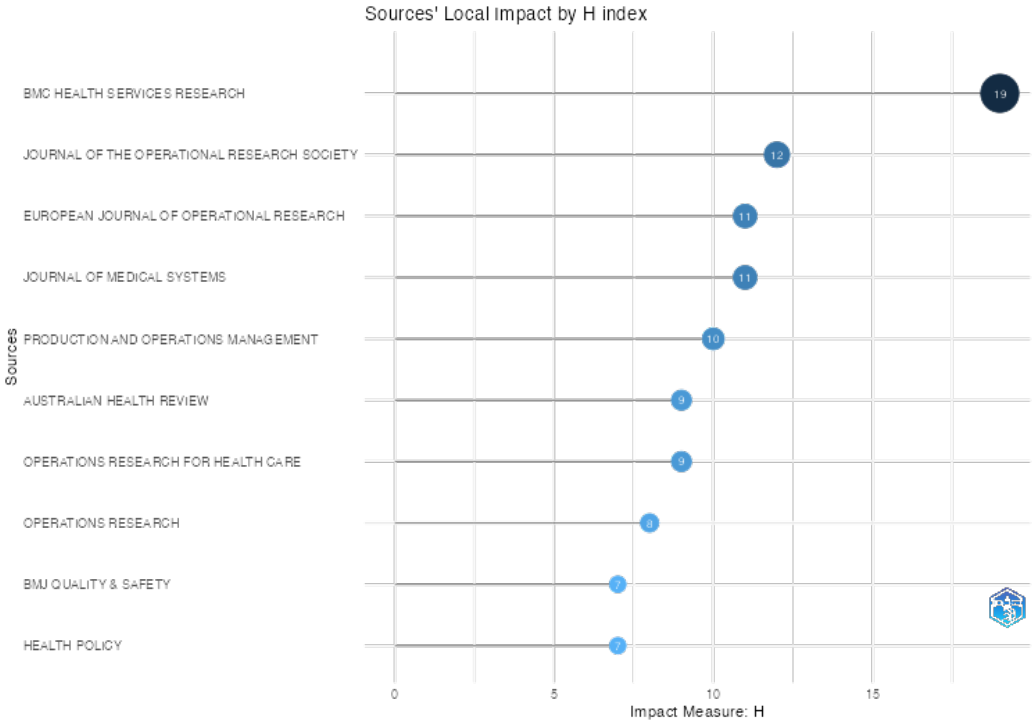

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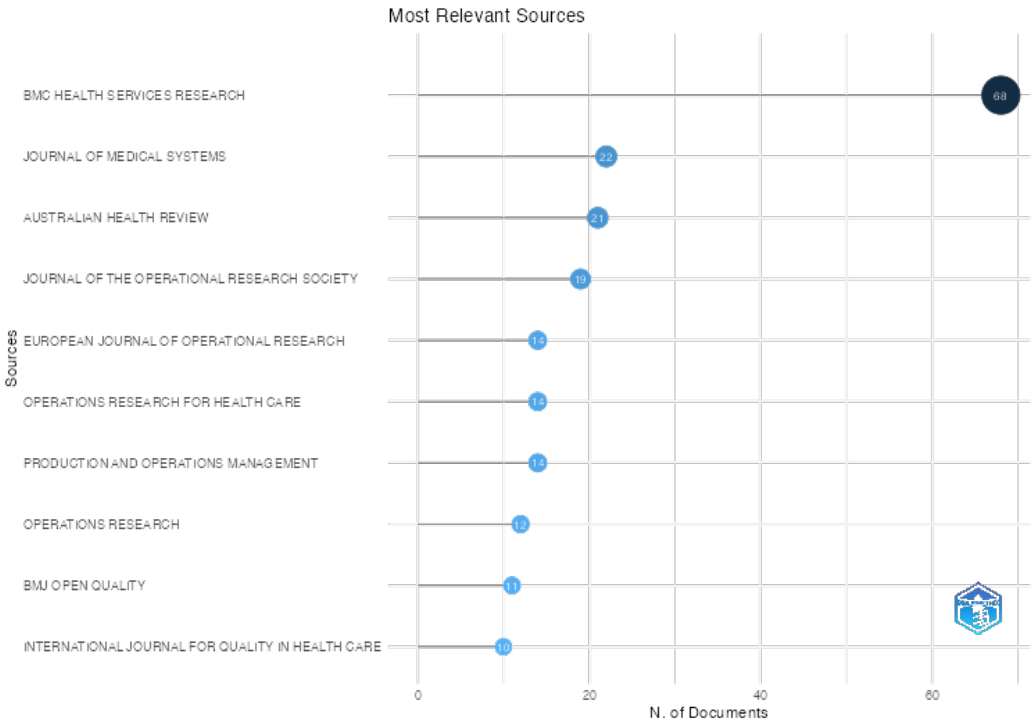

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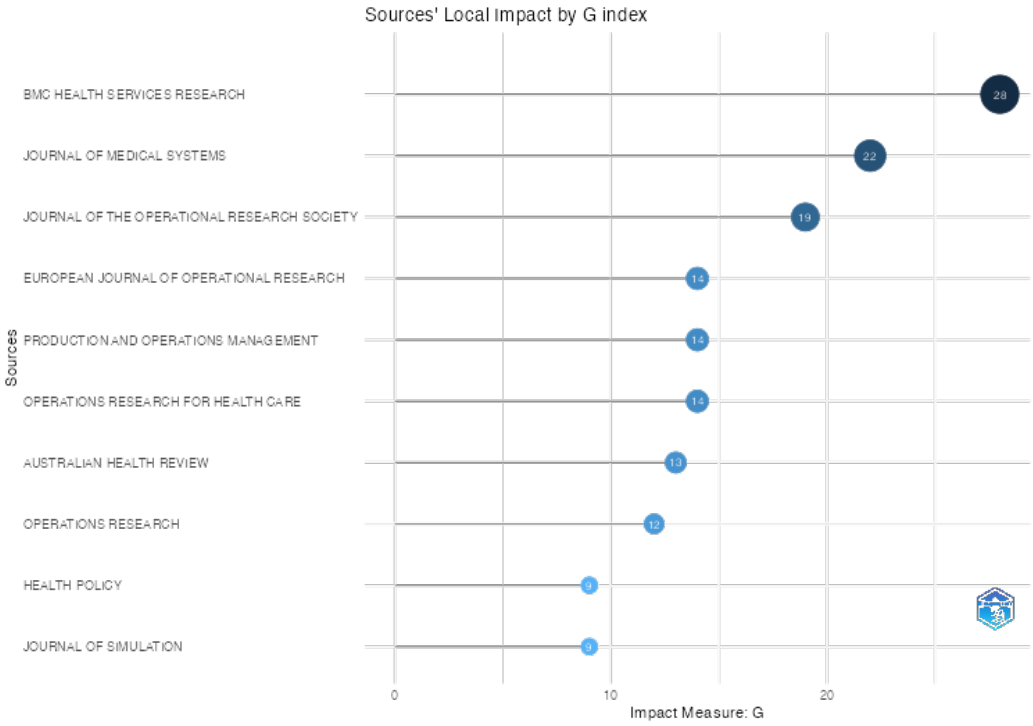
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OPERATIONS RESEARCH FOR HEALTH CARE
AUSTRALIAN HEALTH REVIEW
OPERATIONS RESEARCH
HEALTH POLICY
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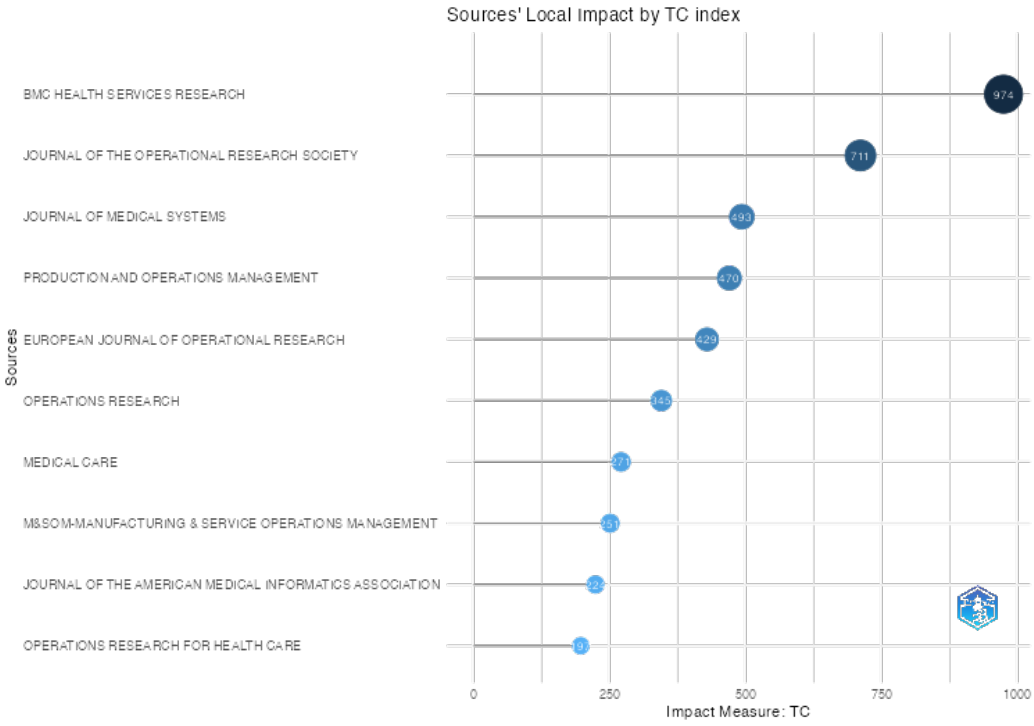
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OPERATIONS RESEARCH
MEDICAL CARE
M&SOM-MANUFACTURING & SERVICE OPERATIONS MANAGEMENT
JOURNAL OF THE AMERICAN MEDICAL INFORMATICS ASSOCIATION
OPERATIONS RESEARCH FOR HEALTH CARE
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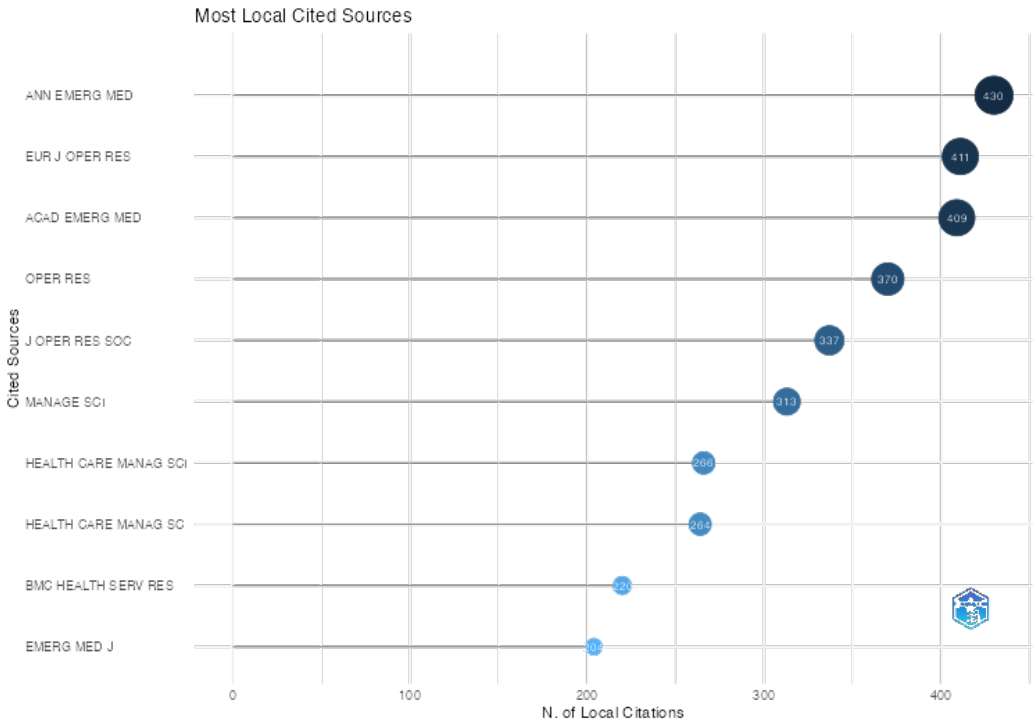

Document analysis (f) Top 10 Most Global Cited Documents; (g) Top 10 Most Local Cited Documents (h) Top 10 Most Local Cited References

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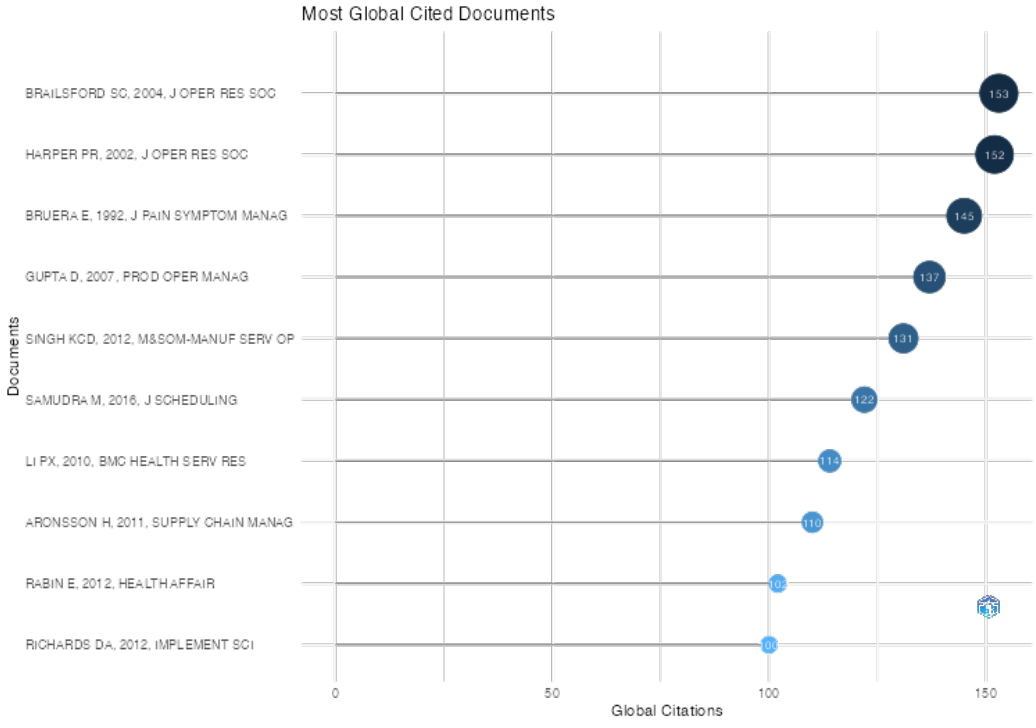

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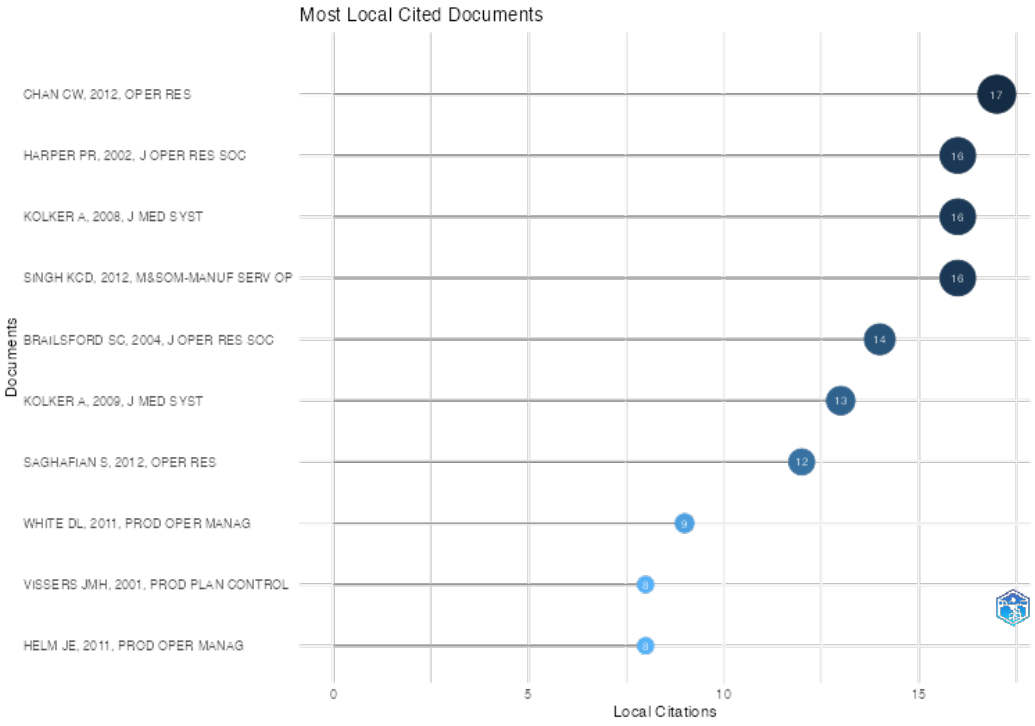
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KOLKER A, 2009, J MED SYST
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VISSERS JMH, 2001, PROD PLAN CONTROL
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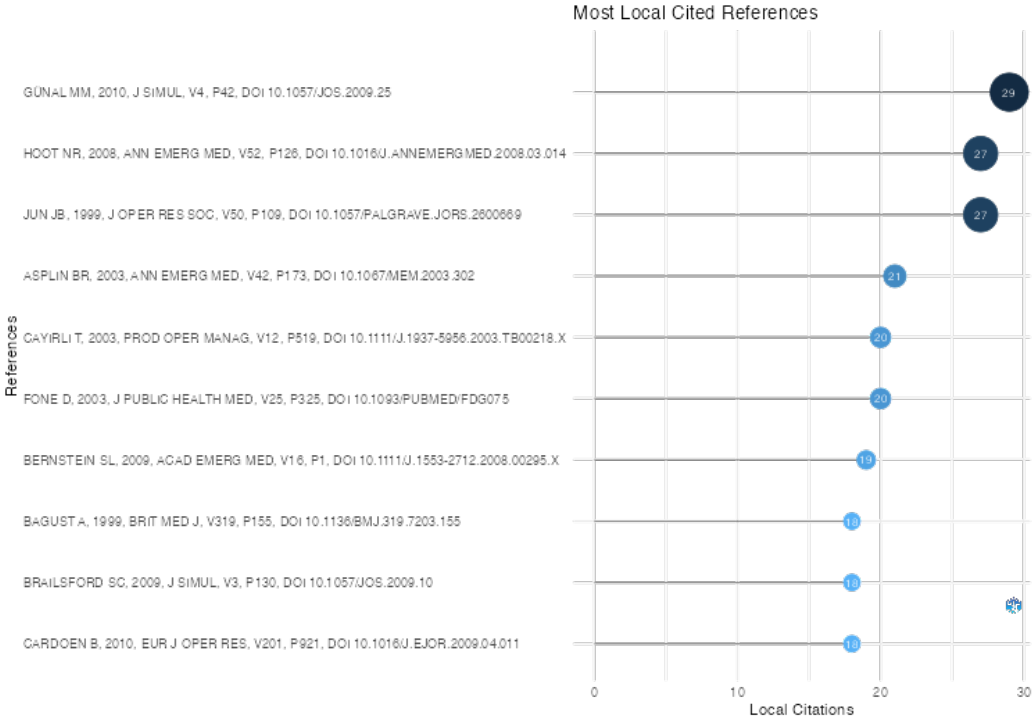
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Local Citations

2. Development trajectories of the Operations Management function in Italian healthcare organizations[2]

Background: The term Operations Management (OM) refers to the set of tools, roles and procedures that characterise the functioning of an organisation's processes to ensure efficient (waste-free) and effective production of the final output (Davies and Walley 2000, Langabeer II 2008).

Purpose: This study aimed to investigate the state of the actual dissemination and implementation of the OM function in healthcare organizations by addressing the following two questions: (i) what are the most common and utilised tools and models in operations management?, (ii) what are the most significant perceived obstacles?

Method: A questionnaire was developed: the constructs of interest were defined after a systematic literature review. The administered questionnaire was structured around six main sections: (i) hospital characteristics; (ii) tools and projects; (iii) organizational structure; (iv) planning and control; (v) human resource management; and (vi) barriers.
The study included healthcare organizations located in the Lombardy region that met one of the following criteria (i) public healthcare institutions (hospitals or ASST), (ii) hospitals and private institutions with more than 400 beds.
In 2016, the Region of Lombardy initiated the social health care reform through Resolution No. X/5513 of 2 August, which also included a reference to the establishment of an operations management function in health care organizations.
On a target population of 40 units, the response rate was 65%.

Results: This study went beyond evaluating specific tools and approaches, examining the entire scope of management and overcoming the mistaken equating of operations management with individual tools and approaches such as lean thinking.
It is highlighted that healthcare organizations have established specific offices for OM, but with variations in composition, objectives, and responsibilities. The use of data-based tools such as Six Sigma and Artificial Intelligence is lacking. Indeed, a primary challenge is the absence of reliable data to manage patient flows.

Keywords: healthcare, operations management, evolution, future developments, data culture

2.1 Introduction

This study wants to analyse the state of the art of the dissemination of Operations Management (OM) function within healthcare organizations and to identify the most relevant organizational conditions for the development of this function in this specific sector. The term Operations Management refers to the set of tools, roles, and procedures

[2] Co-contributor: Prof. Stefano Villa. Paper submitted to “Mecosan”.

that characterize the functioning of an organization's processes to ensure efficient and effective production of the final output (Davies and Walley, 2000; Langabeer II, 2008). The birth of OM can be traced back to 1776, when Adam Smith sparked scientific interest in the study of production processes (Buffa and Elwood, 1980). It can be argued that Smith's concept of division of labor laid the foundation for the development of the operations management function. However, at that time, the term "operations" was not yet used, but rather production management or "manufacturing," an activity closely related to physical transformation processes for the exclusive production of tangible goods (Porter, 1985). The turning point (still within the manufacturing sector) occurred in the 1980s when the Operations Management model developed as a science of lean production process management with the introduction of Japanese models such as Just in Time (JIT) and Total Quality Management (TQM).

Weelwright and Hayes (1980) identified three phases in the evolution of the OM function in the manufacturing sector: (i) initially, the function had a more pragmatic and contingent role in problem-solving in the production chain; (ii) in a second phase, operations became strategically relevant and integrated with company operational mechanisms (*e.g.* budgeting and directional control); (iii) in a third phase, and in many organizations across different sectors, this function became essential for achieving (and maintaining) competitive advantage and value creation. Several years after this contribution, there is now widespread awareness of the relevance of the OM function in the service sector as well. Indeed, both the production of goods and services involve human and physical resources for the realization of a desired output. In the manufacturing sector, OM focuses on the production of goods and their storage in warehouses before delivering them to the customer. Conversely, in the service sector, OM facilitates the simultaneous production and consumption of services (Looy *et al.*, 2013).

In the specific case of the healthcare sector, OM models and tools are undoubtedly fundamental for managing some of the current challenges faced by modern healthcare systems, particularly: (i) increasing demand pressure on growing expenditure budgets; (ii) the aging population characterized by chronic diseases and multiple comorbidities; (iii) shortage of human resources (especially doctors and nurses); (iv) reducing waiting times for elective and emergency/urgent care (*e.g.* the hot topic of emergency room overcrowding) (Vissers *et al.*, 2005; Litvak *et al.*, 2005; Fenech *et al.*, 2018; Villa, 2021).

Despite the recognized relevance in the literature, the operations theme, in Italy and elsewhere, has not yet been fully developed within the healthcare sector (Carbone *et al.*, 2013; Fenech *et al.*, 2017; Fenech *et al.*, 2018). Therefore, this contribution aims to assess the current state of dissemination and implementation of the OM function by analyzing healthcare organizations within the Lombardy Region. Lombardy's 2016 socio-sanitary reform (Resolution X/5513) integrated OM into the Organizational Strategic Plans (cfr. Piano di Organizzazione Aziendale Strategico-POAS) of Health Protection Agencies (cfr. Agenzie di Tutela della Salute-ATS) and Territorial Socio-Sanitary Organizations (cfr. Aziende Socio Sanitarie Territoriali-ASST). Subsequently, the POAS guidelines were updated to align with the National Recovery and Resilience Plan (cfr. Piano Nazionale Ripresa e Resilienza-PNRR), redefining OM as Next Generation Operations Management, tasked with coordinating, monitoring, and reporting on initiatives under the NextGenerationEU program (Resolution XI/6678, April 11, 2022). Building on this analysis, the study wants to provide useful indications to managers and policymakers on the most relevant aspects to invest in for the full development of the operations function in the near future.

This study is organized as follows. The initial section provides an overview of OM in the healthcare sector, highlighting the advantages of applying its principles, tools, and approaches. The subsequent sections focus on the research methodology, followed by the presentation of results and discussion. Finally, the paper concludes with an analysis of the study's strengths and limitations.

2.2 Background

2. 2.1 Operations Management in the Healthcare Sector

The discipline of OM in the healthcare sector translates into the set of choices concerning the management of logistical flows (goods and patients), the planning and control of all production processes supporting healthcare pathways. The pursued goal is to ensure coordination and maximum integration among logistics in various settings, ensuring an efficient clinical care process without resource wastage (Vissers *et al.*, 2005; Giusepi *et al.*, 2012; Fenech *et al.*, 2018; Langabeer II & Helton, 2020; Villa, 2021). Indeed, the areas of application of OM can be summarized as follows: (i) optimization of production areas by seeking the right balance between production capacity and staff workload; (ii)

patient logistics through the improvement of patient flow (from initial access to discharge); (iii) supply chain management ensuring efficient and timely flow of goods and/or services (Heineke, 2005).

However, in evaluating the impact of operations management on the performance of healthcare organizations, it is necessary to consider some specificities that characterize production processes in this sector (Lega *et al*., 2012; Villa *et al*., 2012; Villa, 2021). First and foremost, production and consumption processes require the simultaneous presence of patients and healthcare staff in the same physical and/or virtual space (*e.g*. telemedicine). Furthermore, production processes are subject to high levels of variability attributable to three different factors: (i) clinical variability due to the presence of various pathologies, severity levels, and treatment adherence; (ii) demand variability due to the unpredictability of patient flow (emergency and/or urgency flows); (iii) variability of professionals concerning different skills and approaches of doctors and healthcare professionals (Litvak and Long, 2000; Noon *et al*., 2003; Villa, 2012; Lega *et al*., 2012). These elements of variability inevitably make it more challenging for healthcare organizations to plan production capacity and standardize processes. However, it is important to distinguish between two different sources of variability: natural variability and artificial variability. The former is closely related to the nature and specifics of healthcare production processes and is therefore not eliminable or controllable but can be optimally managed (Lega *et al*., 2012; Villa, 2021). Artificial variability, on the other hand, is caused by dysfunctions in processes and is often linked to incorrect and inadequate behaviours but can be eliminated through organizational strategies (*e.g*. improved capacity planning and management systems, standardized clinical pathways for homogeneous patient subgroups). Reducing variability would ensure significant improvements throughout the healthcare supply chain (Lega *et al*., 2012; Villa, 2021).

Healthcare production processes occur in different settings with very different logistical and organizational characteristics, thus necessarily requiring different managerial and operational strategies. For instance, considering a hospital, at least five different production areas can be identified: (i) the emergency department, (ii) inpatient areas, (iii) outpatient clinics, (iv) operating rooms (ORs), and (v) diagnostic services. Within inpatient areas, there are various possible settings, ranging from critical care areas -

characterized by high levels of natural variability - to settings dedicated to long-term care and rehabilitation with undoubtedly more standardized production processes.

Moreover, concerning the logistics of goods, at least five different categories of products with profoundly different characteristics exist: (i) medications, (ii) medical devices (implantable and non-implantable), (iii) medical supplies, (iv) special foods (foods for special conditions), and (v) non-medical goods (commodities).

Finally, it is important to note how the healthcare sector has no equal regarding the high rate of innovation both in process (consider, for example, the evolution of laparoscopic surgery in recent years) and product (consider, for example, so-called smart drugs or CAR-T therapies).

Several studies in the literature show how the adoption of operations management tools and models can lead to achieving various objectives such as: (i) cost reduction, (ii) variability reduction, (iii) improvement of logistical flow, (iv) productivity improvement, (v) improvement in the quality of service provided, and (vi) continuous improvement of process functioning (Marsh *et al*., 1995; Twanmoh & Cunninghan, 2006; Stonemetz *et al*., 2011; Langabeer II & Helton, 2020; Pakdil *et al*., 2022).

Over the years, several models and tools have been developed to support the operations function. For example, consider the quantitative approach of Six Sigma, aimed at reducing process variability, Total Quality Management, which, through the kaizen philosophy, seeks continuous improvement of processes and organization (Chase *et al*., 2001). Furthermore, no less important is the Lean thinking model (or Toyota Production System), which brings together tools and techniques already present in other approaches, such as process management, visual mapping, or real-time control of the production process progress, waste elimination, and transition from push to pull logics (Villa *et al*., 2012).

2.2.2 Benefits of Applying Operations Management Logic, Tools, and Approaches

From the literature of the last two decades, there is evidence of a rapid dissemination of the theme and application of Operations Management techniques and approaches, especially in support of strategic, tactical, and operational planning processes. Li and colleagues (2002) analysed the role of operations in supporting strategic decisions in American community hospitals. They identified two types of strategic decisions: long-

term decisions that define the resource planning system necessary to carry out the main activities of a hospital and intermediate tactical decisions that include planning and control, workforce management, and quality improvement. The authors found that intermediate operations decisions impact the costs, quality, and financial performance of a community hospital after structural location and size decisions have been established. They recognized a paradigm shift in demand management, moving from a reactive approach to a proactive approach (planning demand in relation to supply levels). Through the described model, hospitals could understand which strategic decisions to make to compete in the market and achieve better outcomes. On the other hand, Nair and colleagues (2013) provided additional contribution to the same topic. The authors emphasized the importance of considering clinical aspects related to quality and the definition of Clinical Care Pathways for homogeneous patient clusters in operations management decisions.

Tucker (2004) has addressed the role of operations in reducing personnel errors and improving patient safety. The same topic was further explored by Dobrzykowski (2015), who introduced the concept of full lean orientation. This approach is useful in developing flexible processes and routines to facilitate the transition from ordinary to dynamic capabilities. Such an approach has a direct and positive impact on patient safety in hospitals by effectively managing unexpected and adverse events. Hyer and colleagues (2009) were among the first to study the impact of adopting the "focused factory" model on hospital performance: the results have shown an improvement in length of stay (LOS) and a significant improvement in net operating margins. Ding *et al*. (2014) contribute to the same line of research. The study results highlight how focusing on a specific clinical condition has a positive impact on production efficiency. Additionally, Carey and Mitchell (2018, 2019), with their research based on the analysis of ambulatory surgery centres in the United States, have demonstrated that focusing on a specific surgical procedure allows centres to reduce costs by achieving economies of scale across a wide range of service volumes.

Cayirli (2008) analysed the support of operations in addressing the ongoing issue of waiting times and appointment scheduling for outpatient visits through patient profiling and clustering. Demand analysis allowed for better organization of appointment scheduling, with appropriate intervals for consultation time characteristics. As a result,

non-value-added time has been reduced for both physicians and patients. The same topic was also explored by Klassen and colleagues (2009), Laganga (2012), and Zacharias (2014). The latter two studies have demonstrated the importance of dynamic scheduling of outpatient slots considering also a high percentage of patients who do not show up.

2.2.3 OM Function in Italy

In the Italian context, the first signs of the spread of the OM function in healthcare organizations are attributable to increased financial pressures and the consequent drastic reduction of available resources. The introduction of the notion of efficiency in the healthcare field is commonly accepted both in the literature and in the management of healthcare organizations. The latter must face significant challenges, including increasing expenditure pressure, an aging population with a consequent higher incidence of chronic diseases, and a shortage of human resources. The solutions are certainly not trivial, and it will be necessary to strike a balance between the tensions towards process efficiency and the need to safeguard the quality, timeliness, and effectiveness of care and assistance processes. Although cost control and resource allocation are reactive measures, truly efficient management should be preventive, ensuring economic and social sustainability. In this context, efficiency becomes preventive, focusing on overall health improvement to reduce the need for hospital services. Budget pressure and demand for high-quality care have solidified the concept of "doing more with less," emphasizing the need to identify optimal combinations of inputs to ensure effective care processes, while respecting efficiency and economical use of resources.

2.3 Objectives and value added of the study

This study aims to investigate the state of the art of the actual dissemination and implementation of the OM function in healthcare organizations by addressing the following two questions:

1. What are the most common and utilized tools and models in operations management?
2. What are the most significant perceived obstacles?

The study starts from evidence, now supported by several studies (see below), that the operations function is fundamental for effectively improving the efficiency and

effectiveness of care processes. Despite this premise, OM has not yet fully spread within the healthcare sector, both in Italy and elsewhere, as evidenced by previous investigations (Carbone *et al*. 2013, Fenech *et al*. 2017, Fenech *et al*. 2018).

As detailed in the previous section, in analysing the development of OM in healthcare, the authors adopt a corporate perspective. It is therefore important not to confuse possible models and tools with the operations function (a set of structured business activities and responsibilities) that continues to exist regardless of the fate, more or less fortunate, of individual managerial fads of the moment.

A first objective of the study is to clarify which models and tools are most used to support OM within healthcare organizations. This represents a distinctive feature of the study, which aims to analyse an innovative managerial function. This means that the authors don't limit only to evaluating the adoption of specific tools and approaches but examine the entire range of elements that constitute a managerial function. In this way, they overcome the common misconception in the literature that sometimes equates operations management with individual tools and approaches (*e.g*. lean thinking).

A second value added of this contribution is to understand which elements of the organizational structure of healthcare organizations are most important for the development of the operations function. The study, therefore, investigates aspects such as: (i) roles and responsibilities; (ii) skills and expertise; and (iii) dimensions and performance indicators. This systemic approach to the operations function is certainly a significant novelty in the landscape of studies on the topic in the healthcare sector. So far, scientific literature has mainly focused on the analysis of the implementation of OM tools and approaches (Carbone *et al*. 2013, Fenech *et al*. 2017, Fenech *et al*. 2018). Nationally, a first census of the OM function was conducted through the analysis of organization documents from the institutional websites of individual healthcare facilities. The survey revealed a very partial formalization of the OM function (Fenech *et al*. 2017). On the other hand, it is difficult to identify international studies aimed at defining the current state of the function, considering also the heterogeneity with which it is interpreted and declined in hospital structures.

In conclusion, as detailed in the dedicated methodology section, compared to previous surveys, the novelty of this research lies in the direct sending of a questionnaire. This approach provides a more updated and comprehensive overview in evaluating the degree

of formalization of the managerial function, allowing for a deeper understanding of the operational dynamics of the organizations involved.

In particular, the survey was administered to healthcare organizations (public and private) in the Lombardy Region. The choice of this region has several explanations: first, within the national context, it was the first - through a specific regional resolution - to establish the Operations Management Office. Secondly, Lombardy is a significant Region in terms of population (more than ten million) and the number of health organizations: 8 Health Protection Agencies (ATS), 27 Territorial Socio-Healthcare organizations (ASST), 120 public hospital facilities, 104 private (accredited and non-accredited) hospital facilities. Specifically, 1 Public Institute of Hospitalization and Care (IRCCS), 22 private accredited IRCCS, 5 private accredited IRCCS-Foundation (Ministry of Health database, 2023).

The management and policy implications drawn from the study results can therefore offer interesting insights for other national and international realities.

2.4 Method

2.4.1 Data collection

As anticipated in the preceding section, the overall objective of this study is to understand the actual dissemination and implementation of the OM function within healthcare organizations. To achieve this goal, the survey instrument was constructed based on a systematic literature review.

In particular, the questionnaire used in the study focuses on patient logistics flows with the aim of understanding how activities such as operating room scheduling, bed management, space organization, patient flow management within the ER, waiting list management for specialist visits, and elective procedures are organized within healthcare facilities. The constructs of interest were defined based on a theoretical framework, literature review, and a panel of experts in this field (Jenn, 2006; Singh, 2017).

Through a preliminary study, the authors conducted a literature review that provided relevant information on the study topics, thus enabling the design and structuring of targeted questions to explore specific dimensions of the application of OM-inspired managerial logic and practices in the healthcare context. The methodological approach is therefore based on a solid theoretical foundation derived from the literature review, aimed

at obtaining an in-depth understanding of the dissemination of OM and its implications in healthcare organizations.

The research data were collected through the Web of Science Core Collectiontm (WoS), which provides comprehensive coverage of scientific publications from over 3,300 selected publishers, including 12,000 high-impact journals. Additionally, it features a vast index with over 1 billion cited references, including up to five citations for each document (Booth *et al*., 2016). For this study, an advanced search was conducted by selecting the "topic" field, which conducts comprehensive searches on title, abstract, and keywords. This search approach is widely adopted in many bibliographic databases (Thananusak, 2019; Mendoza-Muñoz *et al*., 2022).

To obtain as comprehensive a picture as possible on the topic, two search strings were used. The first search string used was (ts=("healthcare") or ts=("health*") or ts=("care") or ts=("health* setting*") or ts=("health* sector*") or ts=("hospital*") or ts=("hospital setting*") or ts=("health* facilit*")). Considering the field of interest, the search was limited to journals belonging to the following category identified by WoS: Operations Research Management Science.

Instead, the second search string composed of (ts=("patient* flow*") or ts=("patient* logistic*") or ts==("operation* management")) was applied and confined to journals belonging to categories identified by WoS as Health Care Sciences Services, Management. Both searches were limited to research articles in English language. Documents such as editorials, book reviews, conference abstracts, and editorials were excluded from the analysis.

Considering the literature review findings, the questionnaire is structured around six main sections: (i) hospital structure characteristics; (ii) tools and techniques; (iii) organizational structure; (iv) planning and control; (v) human resource management; (vi) barriers and open-ended questions.

After general information on the hospital structure, the first section investigates the approaches currently implemented and in use at the facility. The second section gathers information regarding tools and techniques typical of operations management (originating and developed in the manufacturing and service sectors), such as Six Sigma, process reorganization, Lean Thinking.

The third section investigates the presence of an operations management office, its composition (team) and responsibilities, and its position within the organizational chart.
The "planning and control" section collects information on how OM function monitoring is carried out. Specifically, it analyses which indicators are monitored to verify the achievement of set targets (e.g., surgical intervention for femoral fracture within 48 hours). Additionally, it also investigates the impact and benefits of patient logistics projects.
The fifth section seeks to understand how often training events focusing on OM techniques and tools are conducted.
Some questions allowed for multiple-choice answers, while others utilized a five-point Likert scale (from 1-strongly disagree to 5-strongly agree).
In summary, the questionnaire was structured along two main guidelines. Firstly, the authors aimed to understand the actual use in healthcare organizations of various models and tools (*e.g.* lean or six sigma), reiterating the substantial difference between these and the "operations management" function, which aims to improve process performance regardless of the tool/model in fashion at a given historical moment. Secondly, they sought to understand which elements of the company's organizational structure are most relevant to supporting this function by investigating aspects such as: (i) roles and responsibilities; (ii) skills and training paths; (iii) objectives pursued and indicators used in the monitoring phase.
Following its formulation, the questionnaire underwent a pilot test involving several operational managers in the healthcare sector, including a number of Chief Operating Officers. The objective of the pilot test was to gather feedback on the clarity of the questions, the alignment between the survey's objectives and the formulated questions, and the potential for further integration or refinement. The pilot test yielded positive results, allowing for the subsequent administration of the questionnaire to the selected sample.

2.4.2 Sample

In this study, healthcare organizations located within the Lombardy Region were included. Lombardy was selected due to the particular attention it has paid to the Operations Management function. In 2016, Lombardy initiated a socio-sanitary reform

through resolution no. X/5513 of August 2, establishing Health Protection Agencies (cfr. Agenzie di Tutela della Salute-ATS) and Territorial Socio-Sanitary organizations (cfr. Aziende Socio Sanitarie Territoriali-ASST). In the guidelines for the adoption of Organizational Strategic Plans (cfr. Piano di Organizzazione Aziendale Strategico-POAS) in 2016, the indication to establish an operations management function, called Operations Management, was included. Following the definition of the National Recovery and Resilience Plan (cfr. Piano Nazionale Ripresa e Resilienza-PNRR) to recover losses caused by the pandemic, the POAS guidelines were updated. Now, there is talk of Next Generation Operations Management: the structure is also responsible for coordinating, monitoring, and reporting on the implementation of PNRR interventions related to the NextGenerationEU Program within the ASST (Resolution no. XI/6678, April 11, 2022). The questionnaire was sent to healthcare organizations that met one of the following criteria: (i) public healthcare facilities, (ii) hospitals and private facilities (such as clinics) with more than 400 beds. The final target population for this analysis included 40 healthcare facilities (Table 1).

Table 1 - Sample Composition and Reference Population

	Responding Healthcare Organizations	**Population**
ASST	17 (63% out of the total)	27
Private Hospitals	6 (75% out of the total)	8
Public Scientific Research and Healthcare Institutes (IRCCS)	3 (60% out of the total)	5
Total	**26 (65% out of the total)**	**40**

The questionnaire was emailed to Strategic Directorates between May 2021 and April 2022. The survey was sent to strategic directorates because not all healthcare organizations in the sample have an operations management office, while others have only formally established the office without actual assignment of tasks and responsibilities. It was therefore preferred to leave to the directorates the possibility of directing the survey to the most appropriate office. Responses were collected and analysed anonymously and in accordance with privacy regulations.

A response rate of 65% (26 out of 40) was recorded, with a non-adherence rate to the research of 2% (1 out of 40), and a non-response rate of 35% (14 out of 40). The breakdown of the sample was as follows: 6 private facilities and 20 public facilities. Of the latter, 85% (17 out of 20) were ASST and 15% (3 out of 20) were Scientific Research and Healthcare Institutes (cfr. Istituto di Ricovero e Cura a Carattere Scientifico-IRCCS). Regarding the role of the questionnaire compiler, it emerged that the majority (42%) are operations managers, often also heading the Operations Management office. 38% (10 out of 26) are Medical Directors, with a minority represented by supply chain managers (4%) and planning and control managers (4%).

2.5 Results

Regarding the organizational structure (section 3 of the questionnaire), the available data show that out of a total of 26 healthcare facilities, 69% (18 out of 26) have an Operations Management office. As highlighted by the data in Table 3, the individuals comprising this office have different professional backgrounds, depending on the cases analysed. In the field of management, roles and professions are not as rigidly codified as in medical disciplines (for example, to become an anaesthesiologist, one needs a specialization in Anaesthesiology and Intensive Care), allowing individuals to be operations managers with degrees in economics, medicine, nursing, engineering, and so on.

It is worth noting that none of the healthcare organizations included in the sample had a genuinely multidisciplinary team with the simultaneous presence of various professions. Concerning the organizational placement of the Operations Management office among the healthcare organizations in the sample, it typically reports to the general management (44% of cases) or the medical management (39%). An open issue is the possible discrepancy between the management of operations and the responsibility system for healthcare production processes, which legally falls under medical management. Except for three facilities where the OM function fully covers responsibilities consistent with the literature, the others state that the main task performed is scheduling outpatient activities. Regarding typical OM tools (section 2 of the questionnaire), from the scores assigned (ranging from 1- not used- to 5- used throughout the hospital), none were found to be widespread and used throughout the hospital (4 < mean > 5). Tools such as process mapping and subsequent process reorganization were moderately widespread and used (3

< mean > 4). Tools requiring significant technological and IT support, such as Six Sigma, Lean Thinking (introduced by Toyota), were still underutilized, with their lack identified as a barrier.

A statistically significant difference (p-value < 0.05) was found between public and private facilities in the use of tools such as Six Sigma and Visual Management Software.

Regarding patient logistics approaches, physical separation of outpatient services (*e.g.* clinics, day hospitals) from inpatient services (*e.g.* hospitalization) (77%) and the creation of departments based on length of stay (73%) were the most implemented. However, only 43% of healthcare facilities have implemented dedicated physical pathways for unplanned emergency/urgent cases, despite studies indicating the importance of managing variability and unexpected events to ensure efficient and effective hospital functioning.

About the impact of patient logistics projects on performance, projects have been shown to affect dimensions such as productivity, efficiency, and time. However, the perceived importance of other significant dimensions by respondents, such as patient satisfaction and health outcomes, was also emphasized. The impact of patient logistics projects on the quality of work of doctors and nurses was perceived to be low.

Consistent with the goals attributed to the Operations Management function, the most widespread indicators (4 < mean > 5) are traditional hospital efficiency indicators such as average length of stay and bed utilization rate. Furthermore, 80% (21 out of 26) of respondent facilities have an Emergency Department, and performance indicators for this specific productive area are widely used. For example, metrics such as the percentage of patients with femoral fracture undergoing surgery within 48 hours and the percentage of hospital admissions from the Emergency Department are widely used.

A statistically significant difference (p-value < 0.05) was found between public and private facilities for indicators such as the percentage of patients discharged before noon and the percentage of patients discharged during the weekend. Most public facilities do not monitor these indicators, unlike private facilities where they are monitored and widespread throughout the hospital.

Finally, an analysis of the barriers encountered by facilities for the implementation and introduction of the OM function revealed agreement on resistance from medical staff, lack of a process-oriented cultural approach, and the absence of an effective information

system. Notably, while resistance from medical staff is perceived as the main obstacle to implementing operations logic, resistance from nurses ranks lower in this ranking. Additionally, among public healthcare facilities - unlike private ones - it is reported as an obstacle that problems related to patient flow management are not perceived as important within the organization.

Table 2 – Implementation of the patient-flow approaches

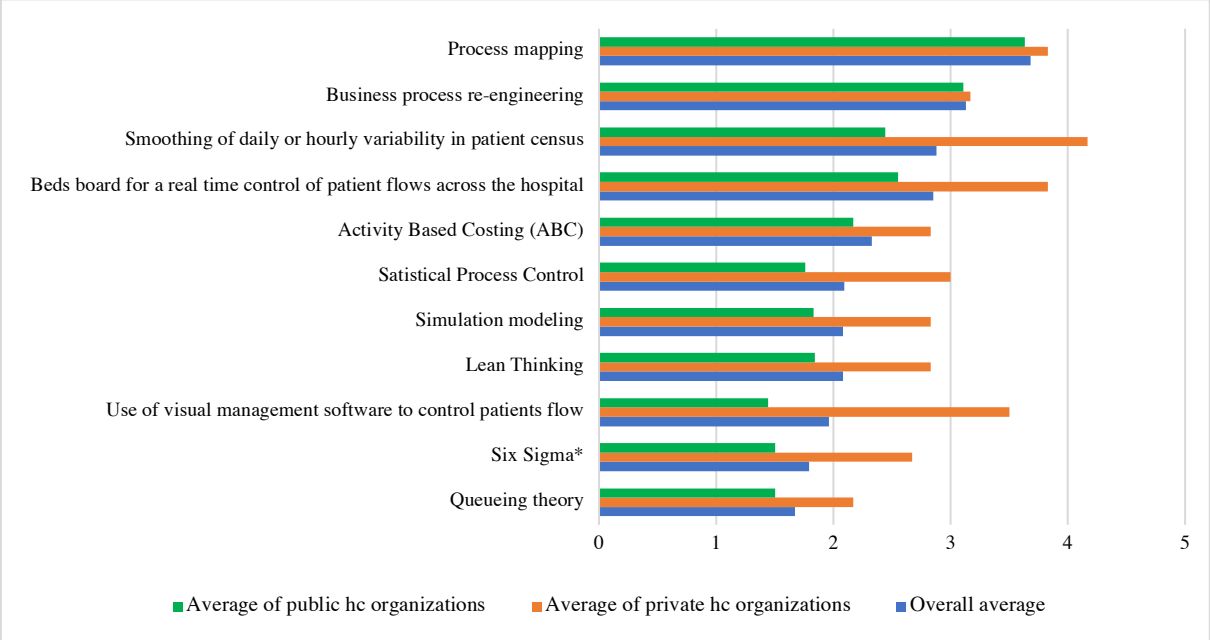
Items		%		Average
		Public	Private	
Does your hospital have a "patient flow unit" (*i.e.* an office/unit/team/person dedicated to the control, management and improvement of patient flows)?		65%	83%	69%
Which, if any, of the following patient-flow approaches are currently used in your hospital?	Step down unit	25%	50%	31%
	Multidisciplinary patient care units	50%	33%	46%
	Wards with patients characterized by low clinical complexity but high nursing burden	10%	50%	19%
	Wards based on the expected length of stay	70%	83%	73%
	Unit dedicated to fragile elderly patients	40%	17%	35%
	The hospital is a specialty centre focalized only on the treatment of a specific clinical condition or patient group	20%	33%	23%
	Organization of hospital assets around a specific clinical condition	20%	33%	23%
	High focus on the provision of specific treatment/surgery	10%	17%	12%
	Physical separation of inpatient from outpatient services	70%	100%	77%

	Dedicated physical pathways for unscheduled emergency cases	30%	83%	42%
	Dedicated operating rooms for emergency cases	50%	50%	50%

Table 3 – Team and responsibilities of the operations management office

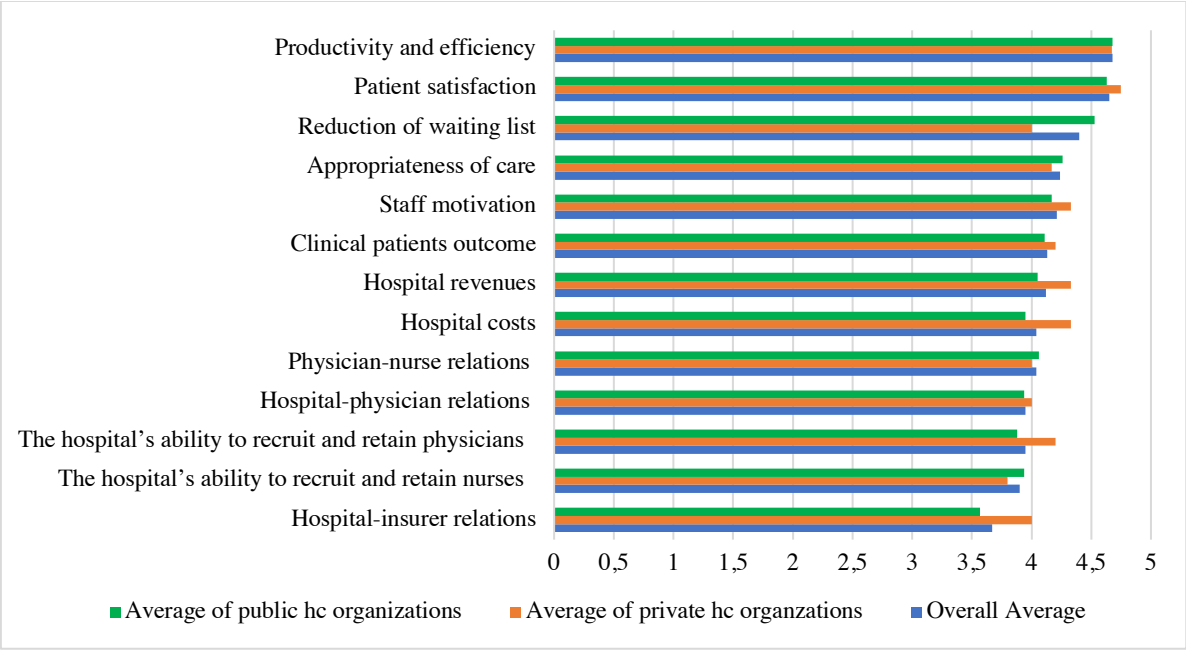
		% Healthcare Organizations
Team	Nursing	44%
	Medical Doctor	22%
	Management	61%
	Engineering	39%
	Statistician	0%
	IT Specialist	22%
	Other	28%
Responsibilities	Operating Room scheduling and management	86%
	Outpatient scheduling system	100%
	Diagnostics scheduling and capacity planning	71%
	ED patient flow's management	57%
	Bed management	57%
	Management of waiting lists	86%
	Management of ambulatory clinics	86%
	Discharge planning	29%
	Utilization review	57%
	Other	14%

Figure 1 - Please select to what extent the following OM tools/techniques are used in your hospital. (1-Not used at all - 5-Used hospital-wide-)



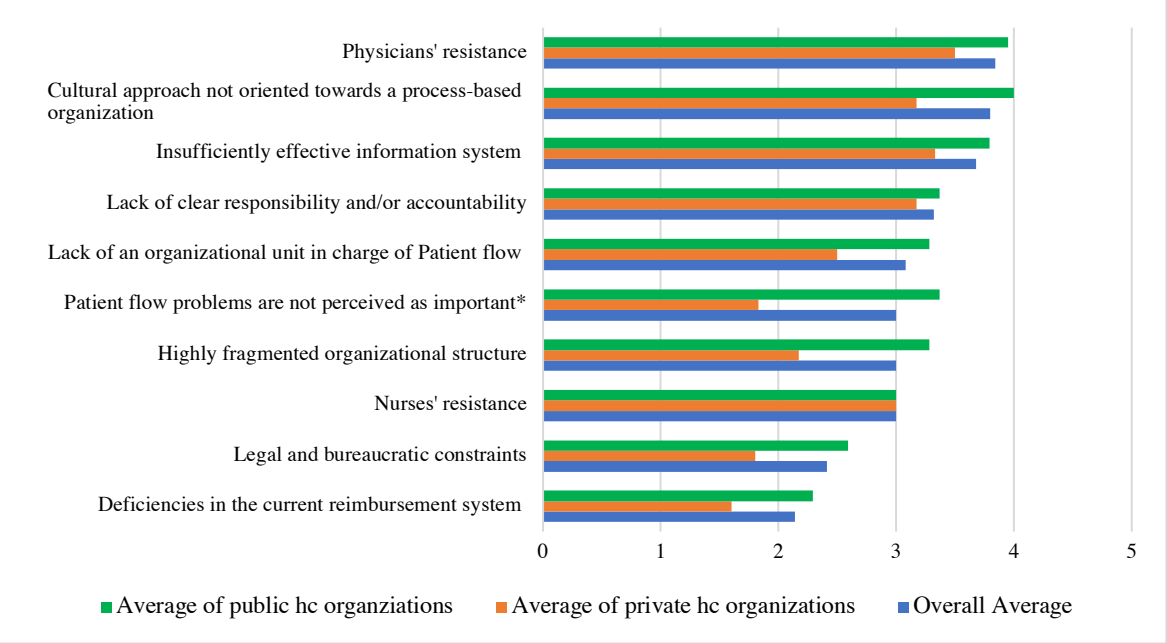
*p-value<0.05
Hc = Healthcare
Bed board for a real time control of patient flow does not involve the use of specific technological tool

Figure 2 - In your judgment, what is the impact of patient flows management projects on each of the following dimensions?
(1-high negative impact - 5-high positive impact -)



Hc = Healthcare

Figure 3 - In your judgment, what are the most relevant barriers to improving patient flows management at your hospital?
(1-not represent a barrier- 5-very relevant barrier -)



*p-value<0.05
Hc = Healthcare

Table 4 - Which of the following indicators are routinely monitored and spread throughout the hospital?
(1-not monitored, 2-monitored but non diffused, 3-only partially diffused, 4-diffused to several production units, 5-diffused throughout the hospital)

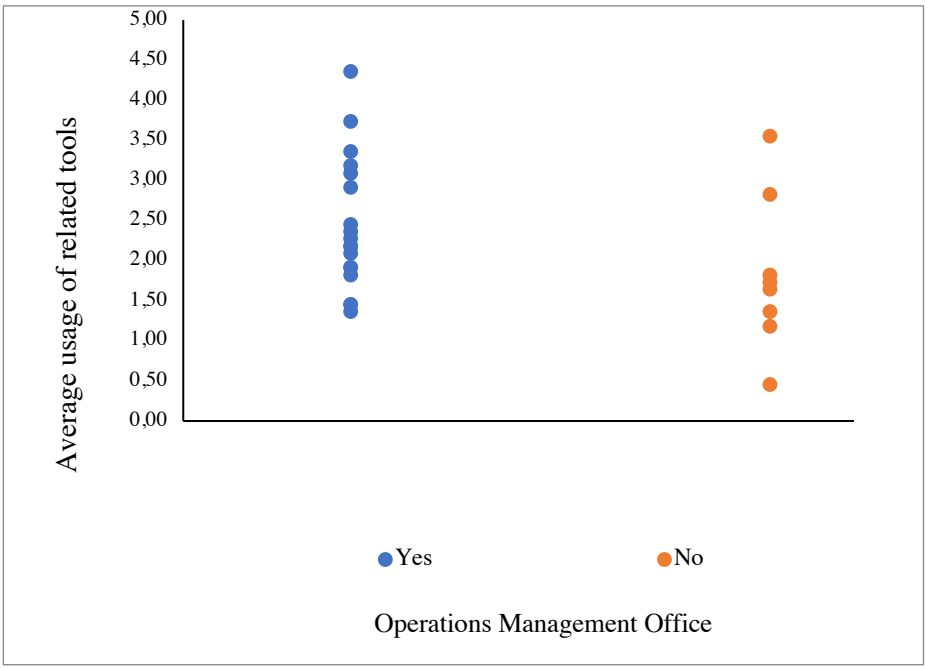
Indicators	Average		Overall Average
	Public	Private	
% of femur fracture patients surgically treated in 48h	4.65	5.00	4.70
Average LOS	4.40	5.00	4.52
Bed utilization rate	4.15	4.67	4.35
Waiting time for imaging diagnostics	4.25	4.50	4.31
Waiting time for outpatient visits	4.25	4.50	4.31
Waiting time to see a doctor	4.20	4.50	4.27
% of hospital admissions from ED	4.13	4.00	4.10
Bed turns	3.80	4.50	3.96
Waiting time for surgical interventions	3.79	4.50	3.96
Surgical time in OR	3.75	4.50	3.92

Daily admissions and discharges	3.60	5.00	3.88
% of medical patients discharged by surgical wards	4.00	3.50	3.88
Waiting time to see the ED doctor	3.93	3.50	3.84
% of surgical patients discharged by medical wards	4.05	3.00	3.81
Utilization rate OR	3.65	4.33	3.81
LOS at ED	3.73	4.00	3.79
% of unscheduled surgical cases	3.58	4.33	3.76
Bed turn-over	3.61	4.17	3.75
% of unscheduled cases	3.58	4.17	3.72
Pre-surgery LOS	3.42	4.50	3.68
Waiting time for minor code patients	3.60	3.25	3.53
Average overtime rate	3.32	4.17	3.52
OR sessions overruns	3.32	4.17	3.52
Average delays for the first procedure of the day	3.21	4.17	3.44
Surgical cases cancelled/postponed	3.11	4.17	3.34
Boarding time	3.21	3.50	3.28
ED division rates	3.00	3.75	3.16
Number of patients not placed in the appropriate settings	2.83	4.00	3.13
% of ED accesses that pass through the OU	2.93	4.00	3.11
OR throughput time	2.95	3.50	3.08
% of OU patients admitted to the hospital	2.87	4.00	3.06
% of patients who leave ED without seeing a doctor	3.07	3.00	3.05
% of patients treated in 4h	3.07	3.00	3.05
Number of visits per day	2.74	4.00	3.04
ICU daily census	2.94	3.33	3.04
OR turnaround time	2.70	3.50	2.88
% of ED patients admitted overnight	2.87	2.75	2.84
OU bed turnover	2.60	3.67	2.78
Number of visits per hour	2.47	3.67	2.76
% of patients discharge over the weekend*	1.89	4.17	2.44
% of patients discharge by noon*	1.74	4.33	2.36
Cases bumped from ICU due to shortage of beds	2.00	2.83	2.24

*p-value<0.05
LOS=Length of Stay

ED=Emergency Department
OR=Operating Room
OU=Observation Unit
ICU=Intensive Care Unit
OR throughput time= OR throughput time (time patient gets IN the OR – time patient gets OUT the OR

Figure 4 – Matrix between the presence of Operations Management office and the average usage of related tools



2.6 Discussions

The results of this study shed light on a complex and heterogeneous landscape about the dissemination and implementation of OM within healthcare organizations in the Lombardy region, offering valuable insights into potential future trajectories for the function. The findings illustrate a nuanced picture of OM's current status. On the one hand, the substantial presence of OM offices in 69% of the surveyed healthcare organizations indicates a growing recognition of OM's strategic importance within healthcare organizations. On the other hand, the predominant focus on managing specific operational areas, such as outpatient clinics and operating rooms, suggests a still somewhat narrow vision, primarily centered on operational efficiency rather than on the creation of systemic value. This finding is consistent with the literature (Wheelwright &

Hayes, 1985), which posits that the evolution of OM necessitates a shift from a focus on operational efficiency to a more strategic and integrated perspective.

An intriguing aspect of the study is the multidisciplinary nature of OM teams, which is increasingly recognized as a critical asset for managing the complexity inherent in healthcare systems. Prior research (Vissers & Bech, 2005; Lega *et al.,* 2012; Marsilio *et al.*, 2022) has shown that multidisciplinary teams provide more flexible and comprehensive solutions, enhancing process optimization. The study underscores the importance of formalizing and structuring OM functions, as well as fostering multidisciplinary teams with diverse skills and expertise. This finding aligns with the notion that the debate over the "ideal" operations manager profile is less pertinent than the need for a well-structured OM function, capable of integrating varied competencies to address the complex demands of healthcare systems.

Furthermore, the study reveals that in most healthcare organizations (90%), OM offices primarily focus on individual operational areas, such as outpatient clinics and operating rooms, with productivity and efficiency being the most frequently cited performance metrics. While these areas remain central to OM's role, the focus on operational efficiency highlights the need for a broader, more integrated approach that transcends isolated production areas to encompass a systemic vision, as suggested by Wheelwright & Hayes (1985). This shift towards a more comprehensive approach is essential for fostering long-term improvements in healthcare delivery.

A critical barrier to the advancement of OM is the cultural resistance observed, particularly from physicians. This resistance emerges as a significant obstacle to the adoption of advanced OM methodologies and tools, such as Six Sigma, Lean Thinking, and data-driven technologies (The use and implementation of these tools is below average, and not all respondents measure all the indicators). The study highlights the pressing need for healthcare organizations to cultivate a data-driven culture, not only to improve operational performance but also to overcome these cultural challenges. This is consistent with the findings of Lindner and colleagues (2021) and Marsilio and colleagues (2022), who emphasize the role of data in driving operational improvements and fostering a culture of continuous learning and adaptation.

Additionally, the contrast between public and private healthcare organizations presents an opportunity for cross-sector learning. Private healthcare organizations exhibit a more

robust use of data to monitor specific operational indicators, such as discharge times and weekend discharges, suggesting a greater emphasis on continuous improvement through data-driven decision-making. In contrast, public sector organizations could benefit from adopting best practices from the private sector to promote a more process- and outcome-oriented approach, in line with the principles of value-based healthcare (Porter, 2010). This shift could significantly enhance the efficiency and effectiveness of public healthcare systems.

2.7 Strengths and limitations

The study makes a significant contribution to the field by analyzing the organization of the Operations Management function in healthcare facilities in the Lombardy region. Additionally, it offers valuable insights for potential future developments and practical recommendations for policymakers, contributing to a deeper understanding of the dynamics at play and areas for improvement.

However, the study has some limitations. In particular, the formulation of the survey is based on a systematic review of the literature aimed at identifying relevant and pertinent information on the topic under investigation, thus ensuring a solid theoretical foundation. Furthermore, to ensure the reliability of the responses, it is important to note that the questionnaire was completed by professionals who hold OM roles or work within the OM office, which strengthens the validity and relevance of the findings.

Finally, it is certainly useful to outline possible future developments of this study, including:

- expanding the sample by including other Italian regions or international countries;
- integrating the research design with the analysis of some case studies, focusing on best practices emerging from the analysis of the study results;
- verifying the presence of a statistically significant correlation between the level of development of the operations function and performance levels (efficiency and effectiveness).

2.8 Conclusions

The results of the survey conducted in the Lombardy Region provide valuable insights for managers and policymakers - at both the national and international levels - interested

in understanding the conditions, opportunities, and development trajectories of the operations function within healthcare organizations. As previously anticipated in the methodology section, this region represents an interesting case for at least two reasons:

1. Lombardy was the first region in Italy to develop the Operations Management function within both public and private healthcare organizations, as evidenced by a specific regional resolution;
2. the Region's population size (comparable to countries like Sweden, Belgium, or the Netherlands) and the diverse mix of hospital structures in terms of size (number of beds) and ownership structures (public vs. private) make it particularly noteworthy.

The study reveals four key findings shaping the future of OM in healthcare organizations. First, the establishment of an OM office significantly impacts organizations, with 69% in Lombardy considering it central to their strategies. These organizations are also more proactive in adopting OM models and tools. Second, OM teams are multidisciplinary, emphasizing the need for formalization to better harness diverse expertise. Third, OM offices currently focus on managing specific operational areas, such as outpatient clinics and operating rooms, primarily aiming at efficiency; however, a more systemic, process-oriented approach is needed.

In conclusion, the findings underscore the necessity of a cultural and organizational transformation within healthcare organizations to foster a more integrated and strategic approach to OM. This transformation involves moving beyond a narrow focus on operational efficiency in individual areas to a more holistic, process-oriented vision that encompasses the entire healthcare system. For more mature healthcare organizations, the future of OM lies in its ability to contribute to value-based healthcare by reorganizing processes and resources around clinical conditions, thus ensuring that healthcare delivery is both efficient and aligned with patient outcomes. Addressing physician resistance, which remains the most significant barrier to the development of OM, and promoting the widespread adoption of data-driven approaches, are critical steps in achieving this vision. In the world of healthcare organizations, the lack of data is not so much a technological problem as it is a cultural one. It is important to develop and disseminate a data culture, sharing a methodology for building indicators and explaining the meaning of trends in some indicators in as integrated and multiprofessional meetings as possible.

Ultimately, the study calls for a more conscious, reliable, and systematic use of data, not merely as a technological necessity but as a cornerstone of a cultural shift towards more effective and sustainable operations management in healthcare.

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2.10 Supplementary materials

Survey: Operations Management in Healthcare organizations

Start of Block: Section 1 – Hospital characteristics

*

Info 1 Hospital's Name

_____

_____

Info 2 City and State

_____

Info 3 (Job)/Position of the respondent

_____

*

Info 4 Email

_____

Q 1.1 Which, if any, of the following patient-flow approaches are currently used in your hospital? Note: (1) We refer to "Intensity of care" as the possibility of assigning wards to patients based on their clinical complexity and/or nursing burden.

(2) Step Down Units (SDUs) provide an intermediate level of care between the Intensive Care Units (ICUs) and the general medical-surgical wards.

☐ Step down unit

☐ Multidisciplinary patient care units

☐ Wards with patients characterized by low clinical complexity but high nursing burden

☐ Wards based on the expected length of stay (e.g. day surgery or week surgery) (4)

☐ Unit dedicated to fragile elderly patients

☐ Others (specify)_____

☐ The hospital is a specialty centre focalized only on the treatment of a specific clinical condition or patient group (e.g. Shouldice Hospital - Hernia Hospital, Oncological Hospital, etc.)

☐ Organization of hospital assets around a specific clinical condition (e.g. diabetes, onco-haematology); Please, detail around which clinical conditions _____

☐ High focus on the provision of specific treatment/surgery (e.g. bariatric surgery, CABG, etc.). Please, detail the treatments on which the hospital has a high focus: _____

☐ Physical separation of inpatient from outpatient services (e.g. day hospital, ambulatory)

☐ Dedicated physical pathways for unscheduled emergency cases

☐ Dedicated operating rooms for emergency cases

☐ Others (specify) _____

Q 1.2 Does your hospital has an Emergency Department?

- ○ Yes
- ○ No

Q 1.3 Please select to what extent you "agree" or "disagree" with the following statements that describe practices and processes currently used in your hospital. (Click on one circle for each item)

Note: (3)The value-based healthcare framework stresses the importance of achieving a better ratio between clinical outcome and cost and it recommends the adoption of five different strategies: (i) redesign of healthcare delivery organization around the clinical condition considering the full cycle of care; (ii) creation of Integrated Practice Units or Care Teams; (iii) performance management systems designed around processes of care; (iv) dedicated facilities for each clinical condition and (v) bundled payment designed around the full cycle of care.

	Strongly disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
a. The hospital organizational model is structured around patient care processes	○	○	○	○	○
b. The hospital's organizational model facilitates coordination across departments and workgroups	○	○	○	○	○
c. Patient care processes are standardized	○	○	○	○	○
d. Healthcare professionals make their decisions on the basis of shared	○	○	○	○	○

and multidisciplinary clinical pathways					
e. The organization of healthcare delivery processes has been designed around the concept of value based healthcare	○	○	○	○	○
f. The hospital's organizational model fosters multidisciplinary work	○	○	○	○	○

End of Block: Section 1 – Hospital characteristics

Start of Block: Section 2 – Tools and projects

2.1 Please select to what extent the following OM tools/techniques are used in your hospital. (Click on one circle for each item)

	Not used at al (1)	Used minimally (2)	Used moderately (3)	Used widely (4)	Used hospital-wide (5)
a. Business process re-engineering	○	○	○	○	○
b. Six-Sigma	○	○	○	○	○
c. Lean Thinking (Toyota Production System)	○	○	○	○	○
d. Process mapping	○	○	○	○	○
e. Beds board for a real time control of patient flows across the hospital	○	○	○	○	○
f. Use of visual management software to control patient flows	○	○	○	○	○
g. SPC (Statistical Process Control)	○	○	○	○	○
h. Smoothing of daily or hourly variability in patient census	○	○	○	○	○
i. Simulation modelling	○	○	○	○	○
l. Queueing theory	○	○	○	○	○
m. Costing approach based on process or	○	○	○	○	○

pathways (Activity-Based costing)					
n. Other (specify)	○	○	○	○	○

End of Block: Section 2 – Tools and projects

Start of Block: Section 3 – Organizational structure

Q 3.1 Does your hospital have a “patient flow unit” (i.e. an office/unit/team/person dedicated to the control, management and improvement of patient flows)?

Note:
[4] We refer to "patient flow unit" as an organizational unit dedicated to the improvement of patient flows crossing the different production units (such as emergency department, inpatient unit, etc.)

○ Yes

○ No

Q 3.1.1 Which is the name of this “Patient flow unit”?

_____

Q 3.1.2 Has this office only a role of internal facilitator providing to department/units directors or general directors the technical and knowledge support to make decisions about the management and control of patient flows logistics?

○ Yes, the office has only the role of internal facilitator providing to department/units directors or general directors technical and knowledge support to make decisions about the management control of patient flows logistics

○ No, has a role of internal facilitator and it is also in charge of the management of hospital assets

Q 3.1.3 If it has a role of internal facilitator and it is also in charge of the management of hospital assets, please selects among the follow's responsibilities (you can click more than one option):

- ☐ Operating room scheduling and management
- ☐ Outpatient scheduling system
- ☐ Diagnostics scheduling and capacity planning
- ☐ ED patient flows' management
- ☐ Beds management
- ☐ Management of waiting lists
- ☐ Management of ambulatory clinics
- ☐ Discharge planning
- ☐ Utilization review
- ☐ Other (specify) _____

Q 3.1.4 Please indicate the professional background of people working for this office:
Nursing: _____
Medical doctor: _____
Management: _____
Engineering: _____
Statistician: _____
IT specialist: _____
Other: _____

Total: _____

Q 3.1.5 Please indicate to whom reports this office/person:

- ☐ Chief Executive Officer
- ☐ Chief Financial Officer
- ☐ Chief Medical Officer
- ☐ Chief Operating Officer
- ☐ Chief Nursing Officer
- ☐ Other (specify) _____

Q 3.1.6 Does this office/role also have responsibility for supply chain management[5]? Answer using a scale from 1 to 5 where “1” means “not at all” and “5” means “it is absolutely under my responsibility”

Note:
[5] The concept of supply chain refers to the sequence of activities that goes from purchasing, warehouse management, and distribution up to the utilization of the supplies (medical or non-medical) at the hospital floor.

	1 (1)	2 (2)	3 (3)	4 (4)	5 (5)
Responsibility of Supply Chain	○	○	○	○	○

Q 3.1.7 Are the responsibilities of this office clearly defined in an official document? Answer using a scale from 1 to 5 where “1” means “not at all” and “5” means “absolutely yes”

	1 (1)	2 (2)	3 (3)	4 (4)	5 (5)
Are the responsibilities defined?	○	○	○	○	○

Q 3.2 Who is responsible for control, management and improvement of patient flows logistics? (you can click more than one circle)

- ☐ Chief Executive Officer
- ☐ Chief Medical Officer
- ☐ Chief Financial Officer
- ☐ Chief Nursing Officer
- ☐ Other (specify)_____

Q 3.3 In your opinion, which competencies are needed to support patient flows logistics decisions within a hospital? Please rank each competence on a scale from “1” to “5”, where “1” means “the competence is not necessary” while “5” means “the competence is essential”.

	1 (1)	2 (2)	3 (3)	4 (4)	5 (5)
a. Nursing	○	○	○	○	○
b. Public Health	○	○	○	○	○
c. Physician	○	○	○	○	○

d. Operations Management	○	○	○	○	○
f. Information Systems	○	○	○	○	○
g. Engineering	○	○	○	○	○
h. Statistics	○	○	○	○	○
i. Financial and accounting	○	○	○	○	○

Q 3.4 On a scale of 1 to 5, with 1 being “strongly disagree” and 5 being “strongly agree”, indicate to what extent you agree or disagree with each statement. (Click on one circle for each item)

	1 (1)	2 (2)	3 (3)	4 (4)	5 (5)
a. Physicians are supportive and collaborative towards patient flow projects	○	○	○	○	○
b. Nurses are supportive and collaborative towards patient flow projects	○	○	○	○	○
c. Administrative staff is supportive and collaborative towards the patient flow projects	○	○	○	○	○
d. Unions are supportive and collaborative towards the patients flow projects	○	○	○	○	○

e. CEO support in implementing patient flow projects is well perceived within the organization	○	○	○	○	○
f. CMO support in implementing patient flow projects is perceived within the organization	○	○	○	○	○
g. CFO support in implementing patient flow projects is well perceived within the organization	○	○	○	○	○
h. Objectives, goals and information related to patient flow logistics are well communicated and shared within the organization	○	○	○	○	○
i. Patient flow logistics objectives are translated into a number of clear ad shared performance measures	○	○	○	○	○

End of Block: Section 3 – Organizational structure

Start of Block: Section 4 – Planning and control

Q 4.1 Is at your hospital "patient flow logistics" explicitly indicated as a priority in its strategic plan?

- ○ Yes
- ○ No

Q 4.1.1 If yes, since when?

Q 4.2 Does the hospital information system provide timely and reliable data to support patient flows management?

	Not at all (1)	To a limited extent (2)	To a reasonable extent (3)	To a high extent (4)	Completely (5)
Are data of Information System reliable?	○	○	○	○	○

Q 4.3a Which of the following indicators are routinely monitored and spread throughout the hospital? (Click on one circle for each item)

	Not monitored (1)	Monitored but not diffused (2)	Only partially diffused (e.g. within the single production unit) (3)	Diffused to several production units (4)	Diffused throughout the hospital (5)
Average length of stay	○	○	○	○	○
Bed utilization rate	○	○	○	○	○
Bed turns	○	○	○	○	○
Bed turn-over	○	○	○	○	○
Daily admissions and discharges	○	○	○	○	○

Waiting time for surgical interventions	○	○	○	○	○
Waiting time for imaging diagnostics	○	○	○	○	○
Waiting time for outpatient visits	○	○	○	○	○
% of patients discharged by noon	○	○	○	○	○
% of patients discharged over the weekend	○	○	○	○	○
Number of patients not placed in the appropriate setting (e.g. Surgical patient on a medical PCU or vice-versa)	○	○	○	○	○
Pre-surgery length of stay	○	○	○	○	○
% of unscheduled cases	○	○	○	○	○
% of surgical patients discharged by medical wards	○	○	○	○	○
% of medical patients discharged by surgical wards	○	○	○	○	○
Overall length of stay (or lead time) at ED	○	○	○	○	○
Waiting time to see the ED doctor	○	○	○	○	○
Boarding time	○	○	○	○	○
ED diversion rates	○	○	○	○	○
% of ED accesses that pass through	○	○	○	○	○

the Observation Unit (OU)					
OU bed turnover	○	○	○	○	○
% of OU patients admitted to the hospital	○	○	○	○	○
% of patients who leave without seeing a doctor	○	○	○	○	○
% of hospital admission from ED	○	○	○	○	○
% patients treated in 4 hours	○	○	○	○	○
Waiting time for minor code patients	○	○	○	○	○
% of femur fracture patients surgically treated in 48 hours	○	○	○	○	○
% of ED patients admitted overnight	○	○	○	○	○
Number of visits per hour	○	○	○	○	○
Number of visits per day	○	○	○	○	○
Waiting time to see a doctor	○	○	○	○	○
Utilization rate OR	○	○	○	○	○
Turnaround time	○	○	○	○	○
OR throughput time (time patients gets IN the OR – time patient gets OUT the OR	○	○	○	○	○
Average overtime rate	○	○	○	○	○

OR sessions overruns	○	○	○	○	○
Cases cancelled/postponed	○	○	○	○	○
% of unscheduled cases	○	○	○	○	○
Average delays for the first procedure of the day	○	○	○	○	○
Surgical time in OR	○	○	○	○	○
Cases bumped from ICU due to shortage of beds	○	○	○	○	○
ICU daily census	○	○	○	○	○

Q 4.4 In your judgment, what is the impact of patient flows management projects on each of the following dimensions? (Click on one circle for each item)

	1 (1)	2 (2)	3 (3)	4 (4)	5 (5)
a. Hospital/Unit Productivity and efficiency	○	○	○	○	○
b. Reduction of waiting lists	○	○	○	○	○
c. Appropriateness of care	○	○	○	○	○
d. Clinical patient outcomes	○	○	○	○	○
e. Patient satisfaction	○	○	○	○	○
f. Staff motivation	○	○	○	○	○

g. Hospital-insure relations	○	○	○	○	○
h. Hospital-physician relations	○	○	○	○	○
i. Physician-nurse relations	○	○	○	○	○
j. The hospital's ability to recruit and retain physicians	○	○	○	○	○
k. The hospital's ability to recruit and retain nurses	○	○	○	○	○
l. Hospital revenues	○	○	○	○	○
m. Hospital costs	○	○	○	○	○

End of Block: Section 4 – Planning and control

Start of Block: Section 5 – Human resource

Q 5.1 How frequently are the following topics included in the hospital training programs? (Click on one circle for each item)

	Every months (1)	Every Year (2)	Every two years (3)	Rarely (4)	Never (5)
a. Lean	○	○	○	○	○
b. Business Process Re-engineering	○	○	○	○	○
c. Benchmarking	○	○	○	○	○
d. Variability control	○	○	○	○	○
e. Six-Sigma	○	○	○	○	○

f. Statistical Control Chart	○	○	○	○	○
g. Visual Management	○	○	○	○	○
h. Process mapping	○	○	○	○	○
i. Costing approach based on process or pathways (Activity-Based costing)	○	○	○	○	○

End of Block: Section 5 – Human Resources

Start of Block: Section 6 – Open questions

Q 6.1 In your judgment, which three out of your hospital's patient flows logistical activities have had the greatest positive impact and why?

○ a1. Activity (1) _____

○ a2. Reason why (2) _____

○ b1. Activity (3) _____

○ b2. Reason why (2) _____

Q 6.2 In your judgment, what are the most relevant barriers to improving patient flows management at your hospital? Evaluate the relevance of each barrier on a scale from "1" to "5" where *"1"* means this element does not represent a barrier at all while *"5"* means this is a very relevant barrier. (Click on one circle for each item)

	1 (1)	2 (2)	3 (3)	4 (4)	5 (5)
a. Physicians' resistance	○	○	○	○	○
b. Nurses' resistance	○	○	○	○	○
c. Cultural approach not oriented	○	○	○	○	○

towards a process-based organization					
d. Insufficiently effective information system	○	○	○	○	○
e. Lack of clear responsibility and/or accountability	○	○	○	○	○
f. Lack of an organizational unit in charge of Patient flow	○	○	○	○	○
g. Higly fragmented organizational structure	○	○	○	○	○
h. Patient flow problems are not perceived as important	○	○	○	○	○
i. Deficiencies in the current reimbursement system	○	○	○	○	○
j. Legal and bureaucratic constraints	○	○	○	○	○
k. Others (specify)	○	○	○	○	○

End of Block: Section 6 – Open questions

3. Organizational structure and operations management conditions in Italian hospital settings: a case study

Background: In recent years, the critical role of management in healthcare system performance has gained recognition. The emergence of Chief Operating Officers (COOs) or Operations Management (OM) functions/units is a strategic response to improve management structures within healthcare organizations. These roles focus on optimizing operational processes, rationalizing resource allocation, and enhancing overall efficiency, which are essential for improving access to care. However, there is still a significant gap in understanding how these roles are organized within hospital structures and how different organizational characteristics might influence performance and access to care. This gap is particularly evident in the Italian healthcare system, where regional regulatory frameworks can impact the effectiveness of management interventions, leading to a lack of standardization across the nation.

Purpose: The aim of this study was twofold: (i) to describe how OM units are organized and how they operate in hospital settings; (ii) to identify combinations of operations management conditions (or factors) and potential alternative paths associated with enhancements in the operational efficiency in hospitals.

Method: The authors collected qualitative and quantitative data. Then, they applied coincidence analysis (CNA) to analyse and to determine which factors were sufficient and necessary to support the OM function and to ensure an improvement in the operational efficiency hospitals. To perform the CNA analysis, the authors followed several steps: (i) calibration of qualitative and quantitative data into binary variables; (ii) data reduction for the analysis; (iii) execution of qualitative comparative analysis. For the development of the model, 14 healthcare facilities (the only ones with an OM office from the initial sample) and 9 conditions were examined, resulting in a total of 126 combinations.

Results: CNA produced one final model with a consistency score of 0.875 and a coverage of 0.778, involving a complexity level of 4. The model identified three distinct pathways to achieving the desired outcome: (i) private ownership of the hospital, (ii) integrated information system, (iii) strategic alignment and organizational role.

Keywords: operations management, implementation, quality of care, coincidence analysis

3.1 Introduction

The Italian National Health Service (Servizio Sanitario Nazionale-SSN) faces numerous challenges, with persistent inefficiencies in access to healthcare services standing out. These inefficiencies are primarily reflected in long waiting times for service delivery and disparities in service availability, highlighting the complexity of the system and the obstacles citizens face in receiving timely and equitable care (Becchetti, 2023).

Such issues undermine one of the SSN's three fundamental principles: equity of access. Ensuring this principle requires that all citizens have access to quality, efficient, appropriate, and transparent healthcare services. Achieving this objective largely depends on effective planning and management of healthcare resources. On one hand, these inefficiencies pose a critical challenge; on the other, optimal management and strategic allocation of resources are essential to ensure the efficiency and effectiveness of provided services (Vissers *et al*., 2005; Langabeer II & Helton, 2020; Villa, 2021).

In recent years, awareness has grown regarding the importance of management in determining the performance and effectiveness of healthcare systems. Specifically, the introduction and development of Operations Management (OM) functions represent a strategic response to the need for improving organizational structures within healthcare organizations. Robust OM practices enable more efficient management of available resources, ensuring strategic allocation to meet the evolving needs of patients and populations (Li *et al*., 2002; Tucker & Spear, 2006; Cayirli *et al*., 2008; Hyer *et al*., 2009). This approach, grounded in demand analysis, addresses contemporary challenges such as the aging population, the rising incidence of chronic diseases, and financial constraints more effectively. However, despite OM's potential to reduce inefficiencies in the healthcare sector, there remains a significant lack of understanding about how these functions are organized within hospitals. In particular, the extent to which organizational and managerial characteristics influence performance and improve access to care remains unclear.

This knowledge gap is particularly evident in the Italian healthcare system, where differences in organizational structures and regional regulatory frameworks hinder standardization and the effectiveness of management interventions. Consequently, OM functions are not uniformly implemented across the national territory.

The objective of this study was twofold: (i) to describe how operations management units are organized and operate within hospitals; and (ii) to identify combinations of OM conditions (or factors) and potential alternative pathways associated with improvements in hospital operational efficiency. Specifically, the term "factor" refers to the managerial and organizational characteristics of the operations management function, which vary between institutions, such as roles, functions, responsibilities, supporting information systems, and strategic planning. This study aims to guide healthcare organizations toward

the effective implementation of OM functions by identifying the favorable management and organizational conditions under which these roles can perform effectively.

3.2 Background: From the OM discipline to the OM function

Operations Management integrates theoretical principles and methodological frameworks aimed at enhancing process efficiency, while its operational function translates these principles into practical applications tailored to specific organizational contexts. This dual nature allows OM to bridge abstract theory and practical execution by employing a comprehensive set of tools and techniques designed to achieve measurable outcomes, such as increased operational efficiency, improved quality, and reduced costs. At its core, OM oversees and coordinates the day-to-day management of operations, ensuring the seamless functioning of production processes while fostering continuous improvement through innovative practices (Bennett & Miles, 2006; Kratzer *et al*., 2018). However, its scope extends beyond production activities, often encompassing auxiliary domains such as procurement, human resources, and information technology. By facilitating a cohesive integration of these diverse functions, OM enables organizations to align operational processes with strategic objectives. This alignment positions OM as a critical intermediary between top management and functional areas, effectively transforming long-term organizational visions into actionable strategies and concrete results (Hambrick & Cannella, 2004; Bennett & Miles, 2006; Kratzer *et al*., 2018).

Despite scholarly discourse suggesting a potential shift in focus away from OM's traditional scope, its relevance persists, driven by the growing complexity of modern organizations, dynamic market conditions, and the increasing need for precise planning and coordination (Bennett & Miles, 2006). OM remains essential as a strategic enabler, transforming high-level corporate objectives into operational excellence. Its role, however, is inherently heterogeneous, varying significantly across industries and organizations. This lack of standardization, while challenging to codify in academic research, underscores OM's adaptability and its capacity to address diverse and evolving organizational demands.

In the healthcare sector, where increasing service demand and constrained resources create significant operational challenges, OM proves indispensable for ensuring sustainability, efficiency, and quality of care. Integrating OM principles into strategic

planning allows healthcare organizations to optimize resource allocation, streamline workflows, and maintain high service standards. Institutions that embed OM within their operational frameworks demonstrate heightened agility in adapting to environmental changes, sustaining excellence in patient care, and fostering a culture of innovation. From improving patient flow and supply chain efficiency to embracing advanced technologies, OM is a cornerstone for generating value and achieving superior outcomes in an increasingly complex healthcare landscape (Vissers & Beech, 2005; Villa, 2012; Villa, 2021).

In Italy, standards and guidelines have been developed to implement and apply OM functions to improve the efficiency of healthcare facilities. A nationwide survey of the OM function was conducted by analyzing organizational documents available on the institutional websites of healthcare facilities. Results (Fenech *et al*., 2017) revealed a partial level of OM function formalization characterized by significant heterogeneity. This finding highlights a critical gap in the standardization and institutionalization of the OM function, suggesting the need for further investigation and targeted interventions to bridge this divide. Greater uniformity in the organizational adoption of the OM function could represent a strategic opportunity to improve the efficiency, effectiveness, and sustainability of the Italian healthcare system.

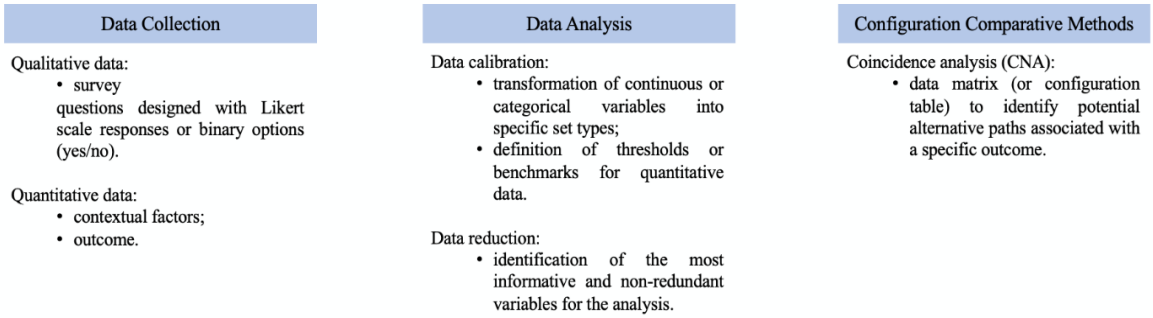
3.3 Method

3.3.1 Study design

The aim of this study was to identify combinations of operations management conditions and potential alternative paths associated with enhancements in the quality of healthcare. The data collection and analysis process were divided into two phases: (i) the development and administration of an electronic survey to evaluate the implementation status of the operations management function at the organizational level, and (ii) the analysis of survey data to discover combinations of conditions linked to improvements in the quality of care (the outcome of interest) using Coincidence Analysis (CNA).

Figure 1 shown the evaluation study design and method.

Figure 1 – Evaluation study design and method



3.3.2 Participants

In this study, healthcare facilities (public and private hospitals) located in the Lombardy Region were included. That Region was selected due to its specific focus on Operations Management.

With the initiation of the regional healthcare reform in 2016 (Delibera n. X/5513, 2 agosto 2016), the guidelines for the adoption of Strategic Business Organizational Plan (Piano di Organizzazione Aziendale Strategico-POAS) mandated, for public organizations, the establishment of an operations management function known as Operations Management. Following the definition of the National Recovery and Resilience Plan (PNRR), the guidelines have been updated, and now they refer to Operations Management-Next Generation (DGR n. XI/6678, 11 aprile 2022).

The study involved and included a total of 20 hospitals.

3.3.3 Qualitative data

Qualitative data were collected through an online questionnaire, sent via email to the Office of Operations Management (where applicable) or to Strategic Directions between May 2021 and April 2022.

The questionnaire focused on patient logistic flows within healthcare facilities, aiming to understand how activities such as operating room scheduling, bed management, space organization, patient flow within the Emergency Department, waiting list management for specialist visits, and elective procedures are organized within these facilities. The research instrument was custom-made, and the constructs of interest were defined after a

literature review and several online meetings with a panel of industry experts, including university researchers and healthcare operations managers.

The survey was structured around six main sections: (i) characteristics of the hospital facility; (ii) tools and techniques; (iii) organizational structure; (iv) planning and control; (v) human resource management; (vi) barriers and open-ended questions. After obtaining general information about the hospital facility, the first section investigated the approaches currently implemented and in use at the facility.

The second part collected information about tools and techniques typical of OM (originating from the manufacturing and service sectors), such as Six Sigma, process reengineering, and Lean Thinking.

The third section inquired about the presence of an OM office, its composition (team), responsibilities, and its position within the organizational structure.

The "planning and control" part gathered information on how OM functions are monitored. Specifically, it analysed which indicators are monitored to assess the achievement of set targets. Additionally, it explored the impact and benefits of patient logistics projects.

The fifth one aimed to understand the frequency of training events focused on OM techniques and tools.

The survey included both open and closed-ended questions (5-point Likert scale).

3.3.4 Quantitative data

In line with the study's objective, the authors identified and examined a set of three indicators as outcome of interest: (i) the proportion of hospitalization for hip fracture with surgical intervention within 2 days in patients aged over sixty-five, (ii) waiting time for tibia and/or fibula fracture surgery, (iii) average number of beds occupied by patients admitted for ordinary hospitalization in the orthopaedics and traumatology ward

The OM office is generally responsible for managing and transforming clinical and administrative processes, making decisions regarding design and strategy, planning and control, and quality. The selected indicators aim to represent the benefits associated with the Operations Management function: optimization in the management and allocation of resources, reduction of waiting times (especially in emergency situations) and decrease in surgical waiting lists. Ensuring the appropriateness of care guarantees that patients

receive the right treatments at the right time, thus reducing the risk of inappropriate or excessive treatments that can prolong hospital stays and occupy avoidable bed space (Brook *et al*., 1986).

The first one is a time-dependent indicator of an emergency process. It is defined as the ratio between the number of hospitalizations with a diagnosis of femoral neck fracture in which the patient underwent surgery within 2 days (the difference between the procedure date and admission date ≤ 2 days) and the total number of hospitalizations with a diagnosis of hip fracture (PNE, 2022). Data, calculated at the individual hospital facility level, are available and accessible online through the National Outcomes Program (Programma Nazionale Esiti-PNE) website.

Femoral neck fractures are particularly common surgeries in the elderly population and are steadily increasing due to the progressive aging of the population. According to international guidelines, the preferred treatment is surgical. In recent years, this indicator has been the subject of various studies, and the literature suggests that long waiting times for surgery are associated with an increased risk of patient mortality and disability (Gdalevich *et al.,* 2004, Carretta *et al*., 2010, Moja *et al*., 2012). General recommendations advocate for surgical intervention within 48 hours of hospital admission for hip fractures, ensuring both health benefits and resource utilization advantages.

The second one is an indicator related to the timeliness of an elective process. It is a waiting times for surgical intervention within 30 days following a fracture of tibia and/or fibula. This indicator measures the ability of the hospital to perform surgery on patients with tibia and/or fibula fractures promptly: specifically, the measured outcome is the execution of the intervention within 30 days from the hospital admission date, and the exposure is provided by the admitting hospital.

Data, calculated at the individual hospital facility level, are available and accessible online through the National Outcomes Program (Programma Nazionale Esiti-PNE) website.

Literature and evidence-based practice suggest an immediate surgical intervention recommendation in cases of wound contamination, compartment syndrome, limb ischemia, or in patients with multiple traumas. In other cases, although there is no time limit for the intervention, it is advisable to perform the surgical operation shortly after the

patient's hospital admission. Any delays in surgical intervention may increase the risk of infections or complications (such as thrombosis) and may prolong the average length of hospital stay for patient.

The guidelines issued by the Italian Ministry of Health, based on evidence-based practices, prescribe surgical intervention for tibia/fibula fractures within 4 days from the date of hospital admission (Ministerial Decree, June 21, 2016). Conversely, the shorter the waiting time for patients with tibia/fibula fractures from admission to surgical intervention, the higher the appropriateness of the care provided.

The third indicator represents a measurement of operational capacity and resource planning. On one hand, it provides information on the average number of patients the department can accommodate simultaneously, aiding in the allocation of key resources (such as medical and nursing staff, equipment) based on the department's demand.

In general, a shortage of beds could cause delays in admissions and suboptimal patient management, while an excess may indicate inefficient use of resources. Dynamic bed management is desirable to respond to fluctuations in demand (predicting peaks based on historical data during certain periods of the year or specific days of the week) and optimize resource utilization.

By monitoring this indicator over time, it is possible to assess the department's effectiveness in managing demand and identify areas for improvement. The data, calculated at the individual hospital facility level, are available and accessible online through the Open Data Lombardia website. Specifically, this data was extracted as an absolute value from the aforementioned website, where both bed-related data and data from the Hospital Discharge Form (Scheda di Dimissione Ospedaliera-SDO) were used to measure it.

3.3.5 Data analysis

To empirically identify conditions or combinations of these, as well as alternative paths to the outcomes, the authors employed the Coincidence Analysis (CNA) methodology. CNA is an analytical technique that utilizes Boolean algebra and minimization algorithms to conduct cross-case comparisons, aiming to pinpoint combinations of conditions that may influence a specific outcome of interest (Baumgartner and Ambuhl 2020). Often, it

is customary to model the presence of an outcome, as the pathways facilitating implementation often differ from those hindering it.

From the literature, it can be observed that the utilization of this approach is increasing in the science research, and it is adaptable to small datasets, with an average of approximately 20 cases (Cragun *et al*., 2016; Whitaker *et al*., 2020; Sperber *et al*., 2022; Charns *et al*., 2023).

To perform the CNA analysis, the authors followed several steps: (i) calibration of qualitative and quantitative data into binary variables; (ii) data reduction for the analysis; (iii) execution of qualitative comparative analysis (Baumgarther and Ambuhl 2020).

This methodology allows for a systematic examination of the interplay between various OM factors and their impact on the desired outcome, providing valuable insights into the implementation process.

3.3.6 Data calibration

To create the raw dataset, the authors extracted the most relevant OM factors from the administered survey. Specifically, section three "organizational structure" of the survey is examined.

The dataset incorporated a total of 5 OM factors: (i) office, (ii) role; (iii) responsibilities; (iv) strategic plan; (v) information system (IS).

The variable *office*, a single item, investigates the presence of an office/unit/team/person dedicated to the control, management, and improvement of patient flows in the hospital. The response options are NO(0)/Yes(1).

After exploring the office's presence, the variable *role* is used to assess its function: (0) only internal facilitator, (1) internal facilitator and knowledge support to make decision.

Responsibilities indicates how clearly the responsibilities of the function are defined in an official document. It provides a 5-point Likert scale response (1-not at all, 5-absolutely yes).

The variables *strategic plan* and *information system* also include a single item each. The first inquiries about the presence of the patient flow approach as a priority in the organization's strategic plan. The latter asks whether the function is supported by the organization's information system for real-time information and to what extent. It provides a 5-point Likert scale response (1-not at all, 5-completely).

According to the literature, a Likert-type response scale could pose a greater challenge for the calibration process because there is no mechanical transformation of a bipolar scale into a unidimensional one (Dusa, 2019). Therefore, in the initial phase of the analysis, the authors followed the literature's guidance by considering a multi-value set to retain the original meaning for variables expressed on the Likert scale.

In addition to the factors identified from the survey, the authors have included some context variables that are commonly considered in studies of healthcare organizations, based on the existing literature (Kaplan *et al*., 2010). The primary context variables include: (i) ownership (0=private, 1=public); (ii) type (0=No IRCCS, 1=IRCCS); (iii) location (0=small-medium urban area, 1=metropolitan area); (iv) size, defined as the number of hospital beds (0=small-medium size, 1=large size); (v) characteristic of emergency department (0=ED, 1=DEA-I Level, 2=DEA-II Level).

All threshold values used for dichotomizing the variables were derived from the literature (Cho *et al*., 2003; Urbach and Baxter, 2004; OECD 2012).

For each of the three outcome indicators, the authors identified a specific threshold value. For hip fracture surgery, they used the threshold value of 60%, which is indicated as the optimal value in Ministerial Decree No. 70/2015. Instead, for the other two, they used the median value. In the case of waiting time for tibia and/or fibula surgery, the authors considered the national median.

Based on study conducted with CNA, the outcome of interest was considered achieved (and thus marked as 1) when at least two out of the three indicators of the set were satisfied (Hickman *et al*., 2020).

Table 1 summarises the calibration process.

3.3.7 Data reduction

Before proceeding with the CNA, the authors conducted a preliminary analysis to optimize the selection of variables. They performed the correlation of Pearson and the Shannon diversity index, excluding highly correlated and uninformative variables (those that did not significantly contribute to variability and provided little information). Following this, only 9 out of 11 variables were retained in the dataset.

To reduce the raw dataset, the authors implemented a configuration approach to factor selection with the application of the "minimally sufficient conditions" (msc) function within the R package "cna".

This method is based on three parameters: consistency (proportion of cases covered by the model, which have the specified outcome present among all cases with that configuration); coverage (proportion of cases covered by the model among all with the specified outcome), and complexity level (number of conditions in a combination) (Ambuhl *et al*., 2020, Petrik *et al*., 2020).

The msc function inspected across only 14 hospitals and all 8 factors to produce a condition table composed of all possible combinations of conditions strongly linked to the outcome of interest. For the condition table, the author included only hospitals with an OM office (the sample size decreased from 20 to 14 units), and this factor was removed because it was constant (the factors decreased from 9 to 8).

During this explanatory data analysis, the msc function was run multiple times at different consistency levels (100%, 95%, 90%, 85%, 80%, 75%). After consulting the results of these tables, the authors identified a small number of "best of class" configurations that met the following criteria: top coverage score within configurations of identical complexity level, aligned with logic, theory and knowledge (for similar procedure, see Roczniewska *et al*., 2023).

Following approach of Miech (2021), the authors categorized each factor individually as binary, using specific threshold values. This approach employed the mathematical output generated by the msc function to identify precise levels at which individual factors were associated with the outcome (presence or absence).

3.2.8 Model Development

After identifying a subset of potential factors and creating a configuration table (Table 2), the models were developed by using model-building functions within the R "cna" software package. The authors conducted the analysis (for the presence of outcome, outcome = 1) and the selection of the final model was based on both score of consistency and coverage.

The target threshold for model selection was a level of consistency and coverage greater than 0.65, in line with published studies using CNA (Baumgartner and Ambühl, 2020; Yakovchenko *et al*., 2020). The goal was to create two models with consistency and

coverage scores >= 65%, aligning with theory and basic knowledge. So, the authors ran the model, starting with a consistency threshold of 0.65 and increasing the threshold in 0.05 increments until reaching 1.

Table 1 – Data calibration

	Variable names	Description	Raw Data Categories	Data calibration
Context factors	Ownership	Ownership	0=Private 1=Public	
	Type	Type of hospital	0=No IRCCS 1=IRCCS	
	Location	Hospital's geographic location		0 = lower 500,000 (small-medium urban area) 1 = upper 500,000 (metropolitan area)
	Size	Number of hospital beds		0 = lower 300 (small-medium size) 1 = upper 300 (large size)
	Emergency Department	Type of Emergency Department		0 = ED 1 = DEA-I Level 2 = DEA-II Level
OM factors	Office	Does your hospital have a "patient flow unit"?	0=No 1=Yes	
	Role	Has this office only a role of internal facilitator providing to department/unit directors or general directors the technical and knowledge support to make decisions about the management and control of patient flows logistics?	0=No, has a role of internal facilitator and it is also in charge of the management of hospital assets 1=Yes, the office has only the role of internal facilitator providing to department/unit directors or general directors technical and knowledge support to make decisions about the management control of patient flows logistics	
	Responsibilities	Are the responsibilities of this office clearly defined in an official document?	1=Not at all 5=Absolutely yes	0 = for scores less than 5 1 = for scores equal to 5

	Strategic Plan	Is at your hospital "patient flow logistics" explicitly indicated as a priority in its strategic plan?	0=No 1=Yes	
	Information System (IS)	Does the hospital information system provide timely and reliable data to support patient flows management?	1=Not at all 2=To a limited extent 3=To a reasonable extent 4=To a high extent 5=Completely	0 = for scores less than 4 1 = for scores greater than or equal to 4
Outcome	Hip fracture	Proportion of hospitalizations for femoral hip fracture with surgery within 2 days in patients over 65 years old		0 = lower 60% (low interventions) 1 = upper 60% (high interventions)
	Tibia and/or Fibula fracture	Waiting time for surgery within 30 days following a fracture of the tibia and/or fibula		0 = upper 4 (high waiting time) 1 = lower 4 (low waiting time)
	Resources	Average beds in the orthopaedics and traumatology ward		0 = lower 23.21 (enhanced capacity to meet the demand for beds in this ward) 1 = upper 23.21 (reduced capacity to meet the demand for beds in this wards)

In Italy, according to guidelines of the Ministry of Health, it is possible to distinguish three types of Emergency Department based on their characteristics.
Emergency Department (ED) Hospital ensures diagnostic assessments and necessary interventions for resolving clinical emergencies.
DEA-I Level performs all the procedures expected of a standard emergency department and handles acceptance functions for more complex emergency cases.
DEA-II Level Hospital ensures higher-level emergency services (hub) such as cardiothoracic surgery, neurosurgery, neonatal intensive care, vascular surgery, and thoracic surgery, following regional programming guidelines. Other specialized units, like burn units and spinal units included in regional planning, are located within DEA-II Level.

Table 2 – Configuration table

CONTEXTUAL FACTORS					OM OFFICE				SET OF INDICATORS			Outcome
Ownership	Type	Location	Size	ED	Role	Responsibilities	Strategic Plan	IS	Hip Fracture	Tibia and/or fibula fracture	Resources	
1	0	0	1	1	1	5	0	4	0	1	0	0
1	0	1	1	2	0	5	1	3	0	1	0	0
1	0	0	1	1	1	5	1	3	0	0	0	0
1	0	0	1	1	0	5	1	5	0	1	1	1
1	0	0	1	1	0	5	1	3	1	1	0	1
1	0	0	1	1	1	1	0	3	0	1	1	1
1	0	0	1	1	1	4	1	4	1	1	1	1
1	1	1	1	2	0	3	1	3	0	1	0	0
1	0	0	0	1	1	1	1	4	1	1	1	1
1	0	1	1	2	1	4	0	1	0	1	0	0
1	0	1	1	1	1	3	1	2	1	0	1	1
0	1	1	1	0	0	5	1	2	1	1	0	1
0	0	1	1	2	0	5	1	4	1	1	0	1
1	0	0	1	1	1	5	1	2	0	1	1	1

3.4 Results

3.4.1 Hospitals characteristics

Out of the 20 healthcare organizations that participated in the survey, 14 (70%) have an OM office and only these are included in the final study conducted by CNA (as anticipated in the method section). 9 out of 14 (64%) reached the outcome: it means that 9 hospitals achieved 2 out of 3 indicators (see condition table).

Furthermore, 12 (86%) of these organizations are public hospitals, and the remaining portion (2 out of 14, 14%) is private. Only 14% of the hospitals are also designated as Scientific Institutes for Research and Healthcare (IRCCS), which are renowned for pursuing primarily clinical and translational research objectives in the biomedical field, as well as in the organization and management of healthcare services, while providing highly specialized hospitalization and care services (Ministry of health). Among these 14 hospitals, the majority (8 out of 14, 57%) is in small-medium urban areas (population < 500,000). Nearly all of them (13 out of 14, 93%) are big healthcare facilities with more than 300 beds.

For additional characteristics of these hospitals, please refer to Table 3.

Table 3 – Hospitals characteristics

	Total N=14 n (%)	**Outcome N=9 n (%)**	**No-Outcome N=5 n (%)**
Ownership			
Public	12 (86%)	7 (78%)	5 (100%)
Private	2 (14%)	2 (22%)	0
Type			
No IRCCS	12 (86%)	8 (89%)	4 (80%)
IRCCS	2 (14%)	1 (11%)	1 (20%)
Location			
Small-medium urban area	8 (57%)	6 (67%)	2 (40%)
Metropolitan area	6 (43%)	3 (33%)	3 (60%)
Size			
Small-medium hospital	1 (7%)	1 (11%)	0
Big hospital	13 (93%)	8 (89%)	5 (100%)
Emergency Department			

ED	1 (7%)	1 (11%)	0
DEA: I Level	9 (64%)	7 (78%)	2 (40%)
DEA: II Level	4 (29%)	1 (11%)	3 (60%)
Role			
Only internal facilitator	6 (43%)	4 (44%)	2 (40%)
Internal facilitator and knowledge support	8 (57%)	5 (56%)	3 (60%)
Strategic Plan			
No	3 (21%)	1 (11%)	2 (40%)
Yes	11 (79%)	8 (89%)	3 (60%)

3.4.2 Characteristics of OM units

Focusing on the organizational structure (as indicated in section 3 of the questionnaire), the currently available data reveal that, out of a total of 20 healthcare facilities that participated in the survey, 70% (14 out of 20) have an Operations Management Office .

From the data analysis, it emerges that the members of this office come from diverse professional backgrounds. In the realm of management, unlike in medical disciplines where roles are more rigidly defined (such as requiring a specialization in Anaesthesia and Resuscitation to become an anaesthetist), skills and backgrounds vary widely, allowing, for example, an operations manager to have degrees in economics, medicine, nursing, engineering, and other fields.

It is noteworthy that none of the examined companies has demonstrated having a genuinely multidisciplinary team with the simultaneous presence of professionals from different areas.

Regarding organizational placement, the OM Office, in the hospitals examined, is usually situated under the general management (in approximately 44% of cases) or under the medical management (in approximately 39% of cases). However, an interesting reflection arises on the potential discrepancy between operational control and responsibilities related to healthcare production processes, which, at least from a legal standpoint, fall under medical management.

Except for three facilities, where the OM function fully fulfils the responsibilities as suggested by the literature, the others indicate that their main role is outpatient activity planning.

3.3.3 Pathways for the presence of outcome

For the identification of the outcome, the CNA analysis identified nine final models with consistency and coverage scores above 0.75, all of which were similar. To address and resolve model ambiguity, the strategies outlined in previous literature were adopted (Johnson *et al*., 2024; Gwayi-Chore *et al*., 2022).

Among the generated models, the one with a consistency score of 0.778, a coverage of 0.778, and a complexity level of 4 was selected. This model is capable of explaining at least 77.8% of the cases where the outcome occurs (outcome = 1) and producing the outcome with the same percentage of accuracy. In this context, it is not possible to determine which model is definitively "correct" based only on mathematical criteria; instead, it is necessary to rely on theory and prior knowledge to guide the selection process. The selected model was preferred because it incorporates three distinct variables, making it more comprehensive compared to other models that combine only two variables. The inclusion of the IS variable was supported by findings from previous literature, which highlight that access to accurate and timely information improves the quality of healthcare and serves as a crucial factor for optimizing and managing information in complex contexts such as healthcare settings (Blaya *et al*., 2014; Bergs *et al*., 2016; Rutherford *et al*., 2017).

M_1 : (Ownership=0) + (IS≥4) + (Role=1*Strategic Plan=1) <-> Outcome=1

The model was composed of three pathways and each of these paths (i.e, combinations of conditions) was sufficient to produce the outcome.

1. Ownership = 0 (the hospital is private)

OR

2. IS ≥ 4 (the hospital information system completely provides timely and reliable data to support patient flows management)

OR

3. Role = 1 (the OM office has only the role of internal facilitator providing to department/unit directors or general directors technical and knowledge support to make decisions about the management control of patient flows logistics)

   AND

   Strategic Plan = 1 (“patient flow logistics” is explicitly indicated as a priority in strategic plan).

Table 4 shows a representation of the solution for the positive model..

Table 4- Solution visualization for the positive outcome (Outcome=1)

	Cases	Outcome	Path 1	Path 2	Path 3	
			Ownership=0	IS>=4	Role=1	Strategic Plan=1
1	F	1	1	1	0	1
2	G	1	1	0	0	1
3	H	1	1	0	1	0
4	I	1	1	1	1	1
5	L	1	1	1	1	1
6	O	1	1	0	1	1
7	R	1	0	0	0	1
8	S	1	0	1	0	1
9	T	1	1	0	1	1
10	A	0	1	1	1	0
11	B	0	1	0	0	1
12	C	0	1	0	1	1
13	J	0	1	0	0	1
14	N	0	1	0	1	0

Note: The red line divides cases with the outcome present (above the red line) from those without (below the red line). The yellow color indicates consistent cases in which outcome was present and covered by one of the two pathways; the green color indicates inconsistent cases.

3.5 Discussions

The aim of this study was twofold: (i) to describe how OM units are organized and how they operate in hospital settings; (ii) to identify combinations of operations management

conditions (or factors) and potential alternative paths associated with enhancements in the operational efficiency in hospitals.

The authors have selected three indicators that represent the benefits of the Operations Management function in terms of appropriateness of care and optimization of resource allocation. These indicators are specific to the orthopaedic and traumatology departments and have garnered attention from the Ministry of Health, which has established desirable standards through various decrees over the years.

Using the innovative CNA approach, which allows modelling the complexity of real-world organizational contexts, the authors identified three different pathways to achieve the expected outcome. These pathways share a common element: the presence of an Operations Management Office.

The first identified path consists of a single contextual factor (private ownership) and corresponds to the findings of the literature: private hospitals have greater capacity to ensure the achievement of expected results. Private hospitals often exhibit more flexible management structures and streamlined decision-making processes, allowing them to rapidly implement innovative OM practices and allocate resources efficiently. Their access to greater financial resources and economic incentives further supports the alignment of operational strategies with patient-centered outcomes, enhancing patient satisfaction and overall performance (Moscone *et al.,* 2012; Quercioli *et al.*, 2013; Gobillon & Milcent, 2016; Kruse *et al.*, 2018).

The second identified route includes a single factor (IS ≥ 4) supporting the presence of the Office of OM. Hospital information systems with an IS score ≥ 4 indicate that the system provides timely and reliable data to support patient flow management. IS tools, such as real-time demand management systems and automated notifications, have been shown to optimize patient flow by enabling real-time monitoring of beds, personnel, and equipment (Nguyen *et al.*, 2022). These systems improve resource allocation and operational efficiency by predicting patient arrivals, reducing wait times, and streamlining the scheduling of surgeries and urgent care. Furthermore, access to accurate and timely data empowers medical staff to make informed decisions, reducing errors and improving clinical outcomes (Blaya *et al.,* 2014; Rutherford *et al*., 2017). This aligns with efforts within the Italian healthcare system to address the lack of standardization and

enhance data collection processes through targeted investments such as those in the PNRR.

The third identified route is a combination of two factors: the role and the strategic plan. This synergy between technical support and strategic plan ensures the effective alignment between the actions of the Office of the OM and the strategic objectives of the organization and directs technical support to the organizational priorities.

Strategic planning is essential for shaping organizational missions and improving processes like patient flow management. The OM Office, conceived as a specialized unit focused on patient logistics, bridges strategy and execution by providing data-driven insights and technical support to department and unit directors (Bost *et al.*, 2015). This alignment ensures that resources and efforts are concentrated on optimizing patient flow logistics, leading to measurable improvements in outcomes such as reduced wait times, enhanced resource utilization, and improved quality of care.

This combination of targeted technical support and strategic prioritization reflects the broader importance of integrating operational and tactical planning. Tactical planning, for instance, enables organizations to adjust to uncertainties like seasonal demand or waiting lists by temporarily increasing capacity through additional shifts or staff. Combined with strategic initiatives, these adjustments result in more effective management of patient flow and better organizational performance (Villa, 2012; Villa, 2021). Such integrated approaches directly impact key metrics, including reductions in Length of Stay (LOS), improved ambulance coordination, and better access to specialized care for vulnerable populations (Crilly *et al.,* 2015; Kane *et al.*, 2016; Winasti *et al.*, 2018).

3.6 Strengths and limitations

The study identified key factors that differentiate successful outcomes from unsuccessful ones, and provided valuable insights. However, small sample sizes limit the findings, and future research should include larger samples to explore potential cause-effect relationships. Only very informative factors with low correlations were included, including tools that depended on specific conditions in the hospital. The use of the triple results measurement reflects some of the advantages of OM functions, but relying on two out of three results may be a limitation. Exclusion of some factors and limited sample

size may affect the results. Future research will expand variables and sample sizes and explore the collaboration between the OM and asset management departments, which have complementary roles.

3.7 Conclusions and managerial implications

This study aims to contribute to the understanding of the OM function within healthcare facilities. Although the literature widely recognizes the benefits of this innovative managerial function, it remains poorly standardized at the organizational level, as evidenced by its placement within organizational charts, its integration into the company's strategic plan, and the supporting information systems. This phenomenon is particularly evident within the Italian healthcare system, known for its fragmentation and decentralization.

The results of the study demonstrate that to effectively achieve its objectives, the OM office requires a fully integrated hospital information system capable of providing real-time data access. Additionally, it is essential for the OM function to receive a prioritized position within the organization's strategic plan. The role of internal facilitator, primarily focused on strategic support for managing patient flow logistics, is markedly different from the inclusion of asset management. The latter significantly expands operational responsibilities, requiring a more diverse skill set and having a broader organizational impact.

The study could provide useful managerial insights for healthcare facilities intending to introduce the OM function and office, guiding them towards the most appropriate and suitable configuration. The recommendations aim to ensure that the implementation of this function leads to significant improvements in operational efficiency and the quality of healthcare services.

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4. Integrated care and patient's satisfaction: evidence from the case of people with epilepsy[3]

Background: Epilepsy is a complex chronic neurological disease often associated with comorbidities, characterized by a quite high level of intensity of service (pharmaceutical consumption and access to healthcare services.

Purpose: The aims of this study were (a) propose a tool to measure the integrated care approach in the case of complex and chronic diseases such as epilepsy; (b) to verify whether integrated care is a feature of healthcare evaluated positively by patients.

Method: The authors tested, developed, and administered a survey to a sample of 474 adults (over 18 years of age) with epilepsy, treated at six specialized centres in different Italian regions. Secondly, they have involved a panel of key experts to support researchers in the design of the protocol and in the interpretation of the results. The overall satisfaction with epilepsy management experience was measured by 7-points Likert scale, from 1 ("not at all satisfied") to 7 ("completely satisfied"). The concept of "integrated care" has been measured though a list of items found in literature review and, then, translated in a set of questions administered through a survey to a sample of patients with epilepsy. Using multiple logistic regression analysis, they tested the presence of association between patients' perception of integrated care approach and satisfaction about the management of their epilepsy.

Results: Patients who have experienced an integrated approach in their care are more likely to declare themselves overall satisfied with the management of their epilepsy (OR=2.48, CI=1.14-5.39).

Keywords: integrated care, patient satisfaction, epilepsy, coproduction

4.1 Introduction

The current healthcare scenario is characterized by the well-known increasing number of chronic multi-morbid individuals. In OECD countries, on average one third of people aged 15 years and over live with two or more chronic conditions (OECD, 2019). Multimorbidity is more common in older age: 36% of adults aged 65 years and older live with two or more chronic diseases on average in 2020 (OECD).

Epilepsy is a complex and chronic neurological disease quite diffused all over the world: about 50 million people suffer from this chronic disorder (World Health Organization, 2022).

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It is often associated with comorbidities and it is characterized by a quite high level of intensity of service in terms of both pharmaceutical consumption and access to health care (ED visits and hospital admissions). It is also recognized as a social disease that involves psychological and emotional aspects (Hills, 2007). An integrated approach is particularly beneficial in the management of this type of diseases (Erskine *et al*., 2018; Rafiq *et al*., 2019). According to the WHO definition, integrated care is *"an approach to strengthen people-centred health systems through the promotion of the comprehensive delivery of quality services across the life-course, designed according to the multidimensional needs of the population and the individual and delivered by a coordinated multidisciplinary team of providers working across settings and levels of care"* (World Health Organization, 2016).

According to multimorbidity guidelines, patient-centred and integrated care are both central components of quality of care (Berntsen *et al*., 2018).

Over the years, the integrated care has proven to be, globally, an effective strategy for healthcare delivery that can ensure both an improvement in the quality of healthcare and an improvement in the quality of the patient's life.

From the literature, there is growing agreement (Atwal & Caldwell, 2005; Andreatta, 2010; Friedland *et al*., 2011; Marsilio *et al*., 2017) that integration plays a significant role in generating a wide range of benefits, such as increased learning and development of people and institutions, better resource utilization, minimization of unnecessary costs, improvements in job performance and work quality, and more efficacious outcomes for patients and their families. Despite this, less research has analysed the satisfaction of a patient with specific clinical conditions in integrated models.

The present paper tries to accomplish two different goals:

1. How can the concept of integrated care be measured in the case of complex and chronic diseases such as epilepsy?
2. Is integrated care a feature of healthcare provision positively evaluated by patients?

The structure of the study is as follows. The first section provides an overview of the theoretical background on the topic. This is followed by the methodology section, then

the presentation of results, a discussion, and finally, the conclusion along with the practical implications.

4.2 Background

4.2.1 Integrated Care Approach

Despite the considerable attention and efforts made to improve quality of care following the 'Crossing the Quality Chasm' report by the Institute of Medicine, significant gaps in delivering care for patients with complex needs remain (Youssef *et al*., 2020).

Providing high-quality healthcare that enhances individual patient care experiences and the overall health of the entire community requires healthcare systems capable of adapting to diverse patient needs, emerging multimorbidity, and individual-specific factors.

To accomplish this goal, it is relevant that the management and organization of health services is designed and structured to establish connectivity, alignment, and collaboration within and between different services, overcoming the typical fragmentation of welfare care systems.

The goal is to seek an enhancement in the quality of care and quality of life, increasing patient satisfaction without waste of resources.

The literature considers integration as a connection or bridge to facilitate the merging of various activities and organizational units for the benefit of patients. Three different levels of integration can be distinguished: (i) the macro level (the entire population), (ii) the meso level (integrated care for group of people with the same disease or specific clinical conditions), (iii) the micro level (integrated care for individual patients).

Specifically, the present study is positioned in the research field analysing and studying integrated care at the meso level: the population target examined is people with epilepsy.

The implementation of integrated care requires the identification of strategies and policies to address changes in several areas such as in workforce, behaviour, governance and financing, but also in organizational models.

The literature mainly identifies three main organizational models to realize and facilitate coordination and integration of care.

First, there is the ‘hub and spoke’ model, where organizations are differentiated according to the complexity of the cases treated. The anchor establishment (the hub) is characterized by the most advanced medical services and highly specialized medical professionals that

deal with highly complex cases, while routine activities are managed by spokes spread over the territory (Lega, 2003).

A second possible organizational model is represented by the so-called Comprehensive Care Network (CCN) firstly developed in cancer care with the goal of assuring that uniformly optimal care is provided as close as possible to patient's home. This model implies that care is delegated to a network where each structure / practitioner has a well-defined and specified role covering the full cycle of care –from diagnostics to care planning, treatment delivery, supportive care, psychosocial support, palliative and survivorship care, and research – but without having to have everything focused in a single centre (Federici A., 2014; Marino *et al*., 2018).

The third and last model is the so-called Comprehensive Care Centre (CCC) where all the tools and skills needed for care are located within a single structure that oversees the integrated and overall management for a specific disease. The CCC falls into the category of the specialty-focused hospital; around which there is extensive literature (Herzlinger, 1997; Meyer, 2008; Porter, 2008; Andreatta, 2010) that recommends focusing on a specific treatment or disease as an approach to enhance quality, efficiency and integration of care delivery.

Several studies (Levin *et al*., 2009; Hopman *et al*., 2016; Marino *et al*., 2018; Rafiq *et al*., 2019) show the relevance of concentrating in one centre technologies, competences, and skills to realize a better and more integrated care for complex and chronic patients. The study conducted by Rafiq and colleagues (2019) proves the benefits of an integrated centre capable of providing all the services and professionals (*e.g*. nephrologists, cardiologists and endocrinologists) needed by complex patients with multiple chronic conditions (MCC) of diabetes, cardiovascular and kidney disease. According to this model, patients obtain all necessary treatments at a single location instead of visiting different specialties at different locations as in traditional care model. In light of its characteristics, the CCC model appears more aligned in ensuring support for patients with chronic conditions, surpassing the typical fragmentation of welfare systems.

In order to function properly, the above-mentioned integrated organizational model requires the development of multidisciplinary working cultures, the adoption of evidence-based clinical pathways and protocols, effective resource management, investments in

technology, continuous monitoring and improvement of performance (Levin *et al*., 2009; Hopman *et al*., 2016; Marino *et al*., 2018; Rafiq *et al*., 2019).

Among the main success factors there are patient involvement (patient-centred model) and patient satisfaction.

4.2.2 Patient satisfaction

The integrated care approach seems to offer various potential benefits, including potential improvements in physical and behavioural health outcomes, increased access to services, and potentially higher satisfaction (Black *et al*., 2021).

Some studies have demonstrated that when patients were highly satisfied, it was linked to better record-keeping, medication use and adherence to treatment recommendations. This contributes to an overall improvement in the continuity of care. (Prakash, 2010; Black *et al.,* 2022).

Several different definitions of patient satisfaction have been proposed in the literature. According to Donabedian's quality measurement model, patient satisfaction is defined as Patient-Reported Outcome Measure (PROMs). Patient satisfaction is one of the main indicators used to measure the quality of healthcare: the literature agrees on the positive relationship between patient satisfaction and quality of care.

It is necessary to tailor the patient satisfaction measurement tool to the integrated care model. An important consideration within integrated healthcare settings involves the capacity to distinguish elements of integrated healthcare from conventional healthcare approaches to identify aspects of the integrated health care practice that are most beneficial from the patient perspective.

Singer and colleagues (2011, 2013) developed and validated a framework for measuring integrated care for patients with multiple and complex chronic conditions. It was composed of seven dimensions: five dimensions are related to coordination (coordination within care team, coordination across care teams, coordination between care teams and community resources, continuous familiarity with patient over time, continuous proactive and responsive action between visit), the others to patient centred (patient centred, shared responsibility) (Tab.1).

According to this framework, the integrated patient care could be considered as a multidimensional construct, based on two principal dimensions (coordination and patient centred).

From these dimensions, a consolidated composite measure of integrated patient care could be constructed and applied to evaluate the level of overall integration in the delivery of patient care by integrated healthcare organizations (Singer *et al.,* 2011).

Table 1 – Conceptual framework of integrated care from the patient's perspective

Construct	**Description**
Coordination within care team	Individual providers comprise a "care team" that delivers consistent and informed patient care and administrative services for individual patients, regardless of the care-team member providing them. The care team may include physicians, nurses, other clinicians, support staff, and administrative personnel who routinely work together to provide medical care for specified group of patients.
Coordination across care teams	All care teams that interact with patients, including specialists, hospital personnel, and pharmacies, deliver consistent patient care and administrative services, regardless of the team providing them.
Coordination between care teams and community resources	Care teams consider and coordinate support for patients by other teams offered in the community (*e.g.* Meals on Wheels).
Continuous familiarity with patient over time	Care-team members are familiar with the patient's past medical condition and treatments.
Continuous proactive and responsive action between visits	Care-team members reach out and respond to patients before, following and between visits; patient can access care and information 24/7.
Patient-centredness	Care-team members design care to meet the patient's needs and preferences, as well as those of family members and other informal caregivers.
Shared responsibility	Both the patient and his or her family and care-team members are responsible for the provision of care and maintenance of good health; processes enhance patients' engagement in self-management.

Source: Singer, Sara J., Mark W. Friedberg, Mathew V. Kiang, Toby Dunn, and Diane M. Kuhn. 2013. 'Development and Preliminary Validation of the Patient Perceptions of Integrated Care Survey'. Medical Care Research and Review: MCRR 70 (2): 143–64. https://doi.org/10.1177/1077558712465654.

4.3 Method

4.3.1 Study design

The data collection and analysis process can be divided into two phases: (i) the development and administration of a survey to realize a tool for measuring the patient perspective of integrated care; (ii) the data analysis with regression model to demonstrate the possible benefit of these approach on patient's satisfaction.

4.3.2 Participants

The study sample consisted of 474 adults over 18 years of age with epilepsy, treated at six specialized centres (Comprehensive Care Centres) in different Italian regions, who participated in a survey.

Three of these are located in the northern part of Italy, of which two are the main regional reference centres. One is specialized in surgical treatment, while the other aims to ensure therapeutic continuity in the transition from pediatric to adult care. The third one is a Scientific Institute for Hospitalization and Treatment (Istituto di Ricovero e Cura a Carattere Scientifico-IRCCS) and a neurological centre, recognized as a centre of excellence in research and treatment of the most significant neurological diseases.

Only one centre (one of six), is located in central Italy and it is part of a university hospital. The latest two centres, located in the southern part of Italy, are the main regional reference centres and are integral parts of hospital organizations.

The selection of the Centres where the authors have administered the survey has been based on three different criteria:

(i) minimum number of patients treated;

(ii) knowledge and expertise of the director of the Centre;

(iii) willingness of the hospital structure to provide data and share information;

4.3.3 Data collection, calibration and analysis

In the first phase, the authors, with the support of experts of the field (directors of the centres, physicians, patient associations, researchers), developed a specific tool for assessing integrated care in epilepsy (Jenn, 2006; Singh, 2017). The measurement tool created was a questionnaire based on the framework developed by Singer and colleagues (2013) and consists of seven questions (one for each category) aligned with the entire cycle of care for patients with epilepsy (as shown in Figure 1).

The questionnaire was developed utilizing the Delphi method, an iterative research approach frequently applied in health and managerial sciences (Niederberger & Spranger, 2020). This method is a structured process designed to gather and refine the judgments of a panel of experts. Typically, it involves multiple rounds of surveys or questionnaires, wherein responses are refined through feedback loops. After each round, the responses are analyzed, and experts are encouraged to reassess their answers based on the collective input of the group. This iterative process minimizes bias, fosters consensus, and facilitates a more reliable understanding of complex issues. A key feature of the Delphi method is the anonymity of participants, which mitigates the risks of groupthink and promotes independent, candid responses. The primary objective is to converge toward a well-rounded, shared perspective by synthesizing individual insights into a cohesive consensus (J. Skulmoski *et al*., 2007; Niederberger & Spranger, 2020)

In this study, based on the framework developed by Singer and colleagues (2013), the authors organized a focus group with key opinion leaders and conducted interviews with patients to inform the development of the questionnaire. These qualitative steps were aimed at gaining a deeper understanding of the lived experiences and challenges faced by individuals regarding the subject matter.

The qualitative phase included a survey of diverse participants: three drug addicts who had undergone successful surgeries, one who had undergone unsuccessful surgery, seven individuals with undefined medical status, one inoperable patient, and three individuals sensitive to drugs. The objective was to explore their personal experiences, relationships with healthcare providers, interactions with substances, family dynamics, and the role of support associations.

Additionally, a focus group was convened with caregivers, encompassing a range of participants: a caregiver of a 9-year-old child, a caregiver of a 23-year-old child, six caregivers involved in the activities of the FIE and affiliated organizations (ELO), an adult caregiver (spouse), a volunteer caregiver and ELO coordinator, two caregivers of minor children (aged 6 to 16), and one caregiver of an adult child (25 years old). This diverse group provided valuable insights into the caregiving experience and the challenges faced by caregivers.

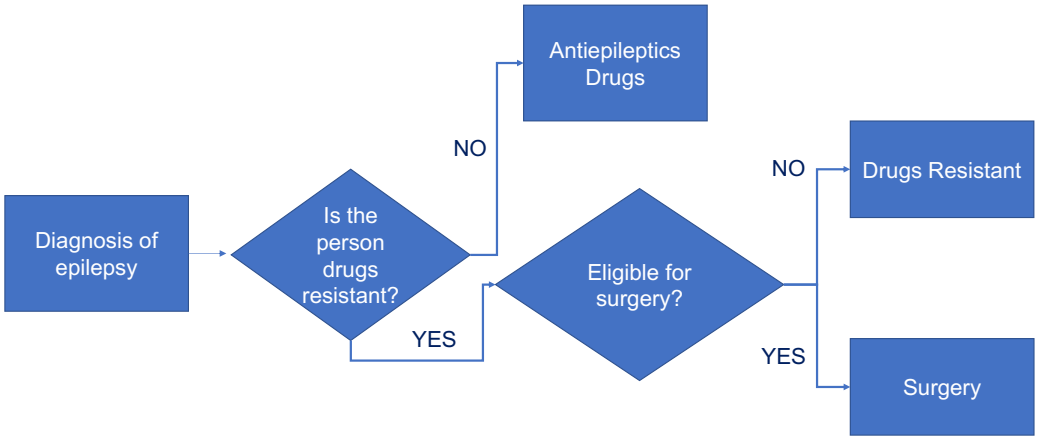
To ensure the effectiveness of the questionnaire, a pilot test was conducted with a representative sample from the target population. This step allowed us to assess the time

required for questionnaire completion, the level of respondent engagement, and to gather oral feedback regarding the respondents' experience. Based on the feedback, suggestions for optimization were made, including recommendations to simplify certain items, reconfigure some questions, adjust the order of presentation, and revise the wording for greater clarity. Moreover, relevance and importance of each individual question have been substantiated and validated through multiple studies focused on epilepsy care (Kaplan and Schachter, 1996; Mur-Veeman *at al*., 2003; Ouwens *et al.,* 2005; Walker *et al.,* 2016; Li *et al.,* 2018; Ryder *et al.,* 2020).

With this survey, the researchers sought to identify the most critical aspects necessary for operationalizing the concept of integrated care in epilepsy, focusing on two fundamental dimensions: patient-centredness and coordination. Of the seven questions developed, three address subjective variables related to patient-centredness, assessing patients' perceptions of care integration within epilepsy centres. Key components of this dimension include the provision of a dedicated physician as the primary point of contact, the delivery of a comprehensive and holistic response to the patient's diverse needs, and continuous support in the daily management of the condition. The remaining four questions pertain to objective variables within the coordination dimension, emphasizing a multidisciplinary approach. This approach ensures that patients receive care from a diverse team of specialists and are supported in the planning and management of diagnostic and therapeutic activities. These questions measure the extent to which patients effectively engage with and benefit from integrated or multidisciplinary services. Responses to the questions regarding overall satisfaction with epilepsy management are captured using a 7-point Likert scale (ranging from 1 - "Not satisfied at all" to 7 - "Completely satisfied").

All participants of six specialized centres voluntarily participated and filled out the anonymous questionnaire, in paper or electronic format, alone or with the help of their caregiver, when necessary, directly at the care centre during the time waiting for a visit. They, also, provided information on personal data and state of health, treatment and the type of treatment.

Figure 1 – The clinical pathway for the management of epilepsy



In the second phase the collected data were analysed using firstly descriptive statistical methods and then a logistic regression analysis to study the "integrated care approach" as predictor of personal satisfaction. This model included other variables, that might have a potential influence on patients' satisfaction as control variables: frequency of epileptic crisis, number of accesses at the centre, need for a caregiver support, anxious state, recent change of therapy or of centre.

According to the literature, it was very complex to measure an integrate care approach (Singer *et al*., 2013). The authors built an "integrated care approach" binary index based on patients' answers to the set of questions formulated to measure the different aspects of integrated care in the management of complex chronic diseases as emerged from the results of literature review. Binary indicator was a composite measure and was derived from each question and respondents were considered to have experienced integrated management in their referral centre if they have met all conditions at the same time. In the specific case, the authors considered satisfied anyone who has given a score of 5, 6 or 7 to all seven questions. To those who met these criteria, the authors assigned a score of 1; otherwise, 0.

Creating a composite binary indicator entails the risk of losing valuable information. On the other hand, several studies have adopted the same approach and rationale for dichotomizing the variable (Piper *et al*., 2023).

The results of the regression analysis have been finally discussed within two distinct focus groups with (i) patients' associations and (ii) the directors of the six centres involved in the study.

The main goal of these focus groups was to identify the organizational characteristics of the Centres capable to enhance coordination and patient centredness the two main dimensions of an integrated approach to care.

4.4 Results

4.4.1 Characteristics of the sample

Regarding the characteristics of the participants, 47% are women, 61% have had epilepsy for over a decade, 40% have at least one comorbidity, and 29% of the interviewees need the help of a caregiver to help manage their disease (Table 2).

Table 2 – Sample Characteristics

Analytic sample characteristics (N = 474)	
Characteristics	**n (%)**
Gender	
Male	249 (53%)
Female	225 (47%)
Status	
Single	262 (55%)
Married	179 (38%)
Divorced	23 (5%)
Widow	9 (2%)
Education	
Primary/Middle school	120 (26%)
High school	246 (52%)
Bachelor's degree	87 (18%)
Post-graduate	18 (4%)
Occupation	
Employee	164 (34%)
Freelancer	52 (11%)
Unemployed jobseeker	79 (17%)
Student	37 (8%)
Retinee	65 (14%)
Unemployed	33 (7%)
Other	44 (9%)
Anxiety/Depression	

I do not feel anxious and/or depressed	242 (51%)
I am moderately anxious and/or depressed	185 (39%)
I am extremely anxious and/or depressed	24 (5%)
I do not know	17 (4%)
How long have you suffered from epilepsy? (years)	
< 1	10 (2,2%)
"1-2"	25 (6%)
"3-5"	53 (12%)
"6-10"	92 (20%)
> 10	276 (61%)
Do you have other diseases?	
Yes	188 (40%)
No	286 (60%)
Do you need help of a caregiver to manage your disease?	
Yes	139 (29%)
No	239 (50%)

According to International League Against Epilepsy (ILAE) and in line with the clinical pathway, the patients with epilepsy can be distinguished in six major different profiles:

1. Patients with diagnosis of epilepsy formulated in the last twelve months;
2. Patients not resistant to drugs (the pharmaceutical treatment works);
3. Patients undefined;
4. Patients resistant to drugs and not eligible for surgery;
5. Patients resistant to drugs and eligible for surgery;
6. Patients resistant to drugs and with the surgery done.

As shown in Table 3, each profile was characterized by several contacts with healthcare services in different forms: (i) access to Emergency Department (ED); (ii) hospital admissions; (iii) visits to Primary Care Physicians (PCP) and (iv) visits to the Centre.
In general, results in Table 2 confirms the indications of literature review (see session 2) outlining that chronic patients have frequent contact with healthcare services.

Table 3 – Contacts with Italian National Healthcare System (last twelve months)

	Profile 1	**Profile 2**	**Profile 3**	**Profile 4**	**Profile 5**	**Profile 6**	**TOT**
Emergency Department (%) (hospital admission from ED)	50% (42.9%)	7.4% (38.5%)	34.4% (9.1%)	27.8% (32.0%)	32.2% (21.1%)	6.8% (28.6%)	**17.3%**
Hospital Admission (%)	14.3%	4.5%	9.4%	22.2%	32.2%	23.3%	**16.0%**
Visits to Primary Care Physicians (mean ± standard deviation)	4.8 ± 5.8	5.1 ± 8.5	6.2 ± 7.8	7.5 ± 10.9	4.8 ± 5.2	2.5 ± 3.9	**5.0 ± 8.0**
Visits to the Centre (mean ± standard deviation)	2.0 ± 0.8	1.5 ± 0.7	2.1 ± 1.0	2.0 ± 1.2	2.0 ± 1.1	1.6 ± 0.9	**1.7 ± 1.0**

The figures of Table 3 give a representation of patients that – on average – do make an intensive use of healthcare services. There are, however, significant differences across patient profiles. For example, patients with a recent diagnosis of epilepsy (formulated in the last 12 months) tend to go to Emergency Department more frequently: in the last twelve months one out of two has asked for emergency services; on the contrary patient profile 6 (patients treated with surgery) tend to go less to Emergency Department.

Patients resistant to drugs and not eligible for surgery (profile 4) have a significant higher rate of contacts both with primary care physicians and specialized doctors.

Finally, in those cases where the pharmaceutical treatment works (profile 2), the authors record a much less number of contacts with healthcare structures.

As outlined in scientific literature (Qu *et al*., 2011; Azmi *et al*., 2017; Larson *et al.,* 2019) patients' satisfaction is influenced by different factors such as the type of service (*e.g.* emergency services or outpatient settings), facility features (*e.g*. waiting time or lay-out ed organization of space), the specific characteristics of the respondent (*e.g.* occupation or presence of comorbidities). Furthermore, a relevant driver of satisfaction is represented by the capability of the service to meet patient's needs and expectations. Therefore, satisfaction is the outcome measure of care service experience that reflects the achievement of providers in regard to meeting patients' needs or expectations.

In our specific case the aim was to understand if a more integrated approach in the provision of care is actually positively evaluated by patients with epilepsy.

Based on the results of the scientific literature, the authors have identified seven different variables (Table 4) to measure the construct of integration in the case of the care of epilepsy.

Table 4 – Variables used to measure integration of care in the provision of epilepsy.

SOURCE	VARIABLES		N.	%
	PATIENT CENDERDNESS			
Kaplan and Schachter, 1996	Do you consider the neurologists of the Centre a reference point in the management of your condition?	Yes	453	96.4%
Kaplan and Schachter, 1996 Mur-Veeman *et al.*, 2003 Ouwens *et al*., 2005	The neurologist guarantees an integrated and holistic answer of all my needs	Agreed	379	95.9%
Walker *et al.*, 2016 Hutchinson *et al.*, 2020	Do you usually find useful practical information for managing daily problems related to Epilepsy from the neurologist or other professionals at the Centre?	Yes	423	87.1%
	COORDINATION			
Walker *et al.*, 2016	The Centre helps me out with the planning and booking of all the necessary healthcare procedures	Agreed	362	86.0%
Li *et al.*, 2018 Hutchinson *et al.*, 2020	If, in the last 12 months, you have carried out visits for the treatment of epilepsy with other professionals in addition to the neurologist, did you carry them out in your centre?	Yes	57 over 112	50.9% over 23.6%
Singer *et al.*, 2013 Walker *et al.,* 2016	If, in the last 12 months, you have carried out instrumental tests for the treatment of epilepsy, have you carried them out in your centre?	Yes	234 over 363	52.9% over 76.6%
Li *et al.*, 2018 Hutchinson *et al.,* 2020	At the Centre I have found all the professionals I needed	Agreed	382	89.0%
	ALL CONDITIONS SIMULTANEOUSLY (experienced integrated care)		**164**	**34.6%**

Initially, the authors performed a simple chi-square test, which revealed a statistically significant relationship between experiencing integrated care and the level of satisfaction. Subsequently, a logistic regression analysis was conducted, appropriate when the

dependent variable is binary. The collected data suggested that a patient who has experienced integrated care was overall satisfied with the management of their epilepsy compared to a patient who has not experienced such a care model.

The study then examined the association of additional variables with the level of satisfaction, such as sociodemographic factors, clinical conditions, and variables related to the patient's care pathway. It is noteworthy that satisfaction was evenly distributed across participants' sociodemographic characteristics, showing no differences based on gender, marital status, education level, or employment status. Similarly, satisfaction was not determined by the healthcare centers involved: although there was some variability in the proportion of satisfied patients across centers, this variability was not statistically significant. It is reassuring that the likelihood of reporting satisfaction with the management of epilepsy was independent of the reference center, at least among the six centers included in this study. Moreover, overall satisfaction was not associated with exemption status or the presence of comorbidities.

Other variables had a significant impact on satisfaction. First, the severity of the condition, measured by the frequency of crisis, inversely impacted the level of satisfaction. As expected, patients without seizures were most frequently satisfied (98%), those with annual seizures were slightly less satisfied (90%), and satisfaction decreased progressively with the frequency of seizures, reaching a minimum of 72% satisfaction among patients with daily seizures.

Anxiety or depressive states were associated with a lower satisfaction rate, with 84% of satisfied respondents who reported anxiety or depression, compared to 94% of satisfied respondents without these conditions. Another well-known factor influencing satisfaction is the lack of continuity in pharmacological therapy: the difficulty in finding an adequate treatment and the need to change daily medications represents a significant issue. Among our respondents, the percentage of those satisfied with the overall management of their condition decreased from 94% to 82% in the group that had changed therapy in the last twelve months. However, the percentage of satisfied patients remained high, indicating that a therapy change is not always viewed as a necessarily negative event.

Finally, a multiple regression analysis was conducted, incorporating all variables found to be associated with the level of satisfaction. This statistical tool helps determine the unique, specific contribution of multiple factors simultaneously to a single event or

phenomenon under study. The statistical analysis (summarized in Table 5) shows quite robust evidence: patients who perceive their care approach as integrated, are more likely to declare themselves overall satisfied with the management of their epilepsy (OR=2.48, CI=1.14-5.39), even taking into account other possible confounding variables such as: frequency of epileptic crisis, number of accesses at the centre, need for a caregiver support, anxious state, recent change of therapy or centre.

Table 5 – Adjusted Odds ratio (OR) and p-value of declaring satisfaction with own epilepsy management experience for patients who have experienced integrated care approach compared to patients who have not. Adjustment for all the other variables in the table.

		Satisfied	
		OR	95% Confidence Interval
Integrated care approach	Yes versus No	2.48	1.14-5.39
Anxiety	Yes versus None	0.44	0.21-0.92
Frequency of epileptic crisis	Annual versus None	0.32	0.09-1.10
	Monthly versus None	0.21	0.07-0.65
	Weekly versus None	0.14	0.04-0.51
	Daily versus None	0.14	0.03-0.59
Presence of caregiver	Yes versus No	0.64	0.29-1.42
Recent change of drug therapy	Yes versus No	0.53	0.24-1.16
Recent change of treatment centre	Yes versus No	0.51	0.15-1.71
Number of access to the centre	2 versus 1	1.93	0.82-4.55
	3 or more versus 1	1.12	0.44-2.85

4.5 Discussions

This study highlights the intricate and multifaceted nature of epilepsy management, emphasizing the necessity for a highly integrated and personalized therapeutic approach. The findings illustrate that the variability in healthcare service utilization across the six

patient profiles reflects the complex and diverse clinical and organizational needs of epilepsy patients. This diversity points to the urgent requirement for treatment pathways that are not only individualized but also adaptable to the distinct characteristics of each patient. By tailoring care to the specific needs and circumstances of individual patients, healthcare providers can ensure more effective management and improved clinical outcomes.

The data on healthcare service utilization provide a valuable perspective on the differences in patient experiences, offering insights that align with existing research (Qu *et al.,* 2011; Azmi *et al.*, 2017) while also revealing new nuances within specific patient groups. For example, newly diagnosed patients (Profile 1) tend to experience frequent emergency situations, as evidenced by the notably high rate of emergency department visits (50%). This finding underscores the challenges faced by these patients in the early stages of their epilepsy journey, where timely interventions and a well-structured support network are crucial. The elevated use of emergency services in this group highlights the importance of early and proactive care, which could potentially reduce the burden of acute events and improve long-term management.

In contrast, surgically treated patients (Profile 6) exhibit a significantly lower reliance on emergency services, suggesting that surgical intervention leads to better disease control and a reduction in the frequency of crises. This finding is a powerful argument for the efficacy of surgical treatments in managing epilepsy, providing a strong case for expanding access to surgical options where appropriate. On the other hand, patients with pharmacoresistant epilepsy who are not eligible for surgery (Profile 4) present a different set of challenges. These patients require ongoing care, reflected in their high frequency of consultations with GPs and specialists. This group underscores the importance of continuous support and tailored management plans, particularly for those with complex or refractory cases, to optimize their quality of life and minimize the impact of uncontrolled seizures.

The findings also highlight the value of an integrated care approach, as there is a clear positive correlation between perceived care integration and overall satisfaction with epilepsy management. This is consistent with existing literature (Walker *et al.,* 2016; Li *et al.,* 2018), which underscores the significance of a coordinated, patient-centered care model in enhancing patient experiences and improving clinical outcomes. However, the

relatively low percentages of patients accessing specialist visits (50.9%) or undergoing diagnostic tests (52.9%) within the Center suggest a gap in the integration of care across various service levels. These findings indicate the need for stronger coordination between primary, secondary, and tertiary care providers to ensure that patients receive comprehensive, continuous care across all stages of treatment. Strengthening this coordination could reduce delays, minimize treatment fragmentation, and ultimately enhance the effectiveness of care delivery.

The evidence gathered from this study strongly supports the CCC model as an effective framework for achieving integrated, patient-centered epilepsy management. However, the success of the CCC model relies on meeting several essential conditions. First, adequate resource availability is crucial. Epilepsy centers must be well-equipped with state-of-the-art diagnostic tools, access to multidisciplinary expertise, and a sufficient patient base to ensure long-term sustainability. Without these critical resources, the comprehensive care required to manage complex epilepsy cases would be difficult to achieve, limiting the model's effectiveness.

Patient profiling plays a pivotal role in ensuring that care pathways are customized to meet the specific needs of different patient groups. A detailed understanding of each patient's condition, treatment history, and support needs is essential for designing personalized care strategies that maximize resource utilization and enhance treatment outcomes. Profiling enables healthcare providers to identify gaps in care and implement strategies that improve the overall management of epilepsy, leading to more favorable patient outcomes.

The integration with primary care is another important element for the successful implementation of the CCC model. The model cannot be limited to specialized epilepsy centers; it must extend to primary care settings. This can be achieved through initiatives such as telemedicine, which expands access to specialist care, and by providing enhanced training to GPs on the management of epilepsy. Additionally, collaboration with patient advocacy groups and community organizations can help bridge gaps in care and provide ongoing support to patients outside of the clinical setting. By ensuring strong communication and coordination between primary care providers and specialists, the model fosters a holistic approach to epilepsy management that benefits patients at every stage of their treatment.

In conclusion, the findings of this study underscore the critical importance of adopting a multidimensional approach to epilepsy management—one that incorporates clinical expertise, a patient-centered approach, and effective coordination across different levels of care. Implementing these strategies not only improves access to specialized treatment but also enhances the overall quality of care, leading to better health outcomes for individuals living with epilepsy. Furthermore, the integration of these elements into a cohesive care model offers a pathway to addressing the diverse needs of patients, improving both the efficiency and effectiveness of epilepsy management.

4.6 Conclusion and practical implications

The results of this study provide key insights along three main directions. First, the statistical analysis clearly shows that epilepsy patients significantly prefer an integrated approach to managing their condition. In a time when policymakers emphasize patient satisfaction and involvement, this finding sends a clear message: achieving an integrated and coordinated care approach should be a top priority. However, the results still reveal a fragmented healthcare system, where patients often seek services outside their centers. The survey results and focus group discussions indicate that a CCC model is more effective in promoting integrated care, particularly in patient-centeredness and coordination. This model better meets patients' needs by offering a structured approach to personalized care and multidisciplinary coordination. Through dedicated support and seamless collaboration between specialists, the CCC is better equipped to provide the integration needed for optimal epilepsy management.

However, three conditions must be met for this model to succeed. First, the center must meet specific criteria: (i) a minimum number of patients to treat, (ii) availability of necessary technologies, and (iii) presence of all required professions and expertise for comprehensive care. Second, the study shows that six different patient profiles require distinct services, with varying impacts on activities and costs. Thus, analyzing patient demand and profiling them based on shared characteristics is essential. This will allow for better resource allocation and care process alignment. As shown in Table 3, patient profiles significantly influence the actual use of healthcare services.

Finally, to ensure access to care, specialized skills from the CCC must be distributed into primary care settings near patients' homes. Experts have proposed potential solutions,

including (i) technology use (e.g., telemedicine), (ii) the introduction of new roles (e.g., case managers), (iii) training and specialization of primary care providers, and (iv) collaboration with patient associations.

The regression model provides strong evidence that an integrated approach positively impacts patient satisfaction. In terms of policy and management, understanding which organizational features best support this approach is crucial. Focus group discussions highlight that key aspects—such as coordinated care planning and multidisciplinary teams—are best achieved through a CCC structured like a focused factory model. However, three conditions are essential for this model's success.

First, centers must meet standards in organization, technology, and available expertise. Second, resources and care pathways should be tailored to patient profiles. Our study identifies six patient profiles with varying access to care, including emergency visits, hospital admissions, and outpatient visits. Finally, spreading the expertise of CCCs into primary care is essential. Two strategies to achieve this include: (1) using technology (e.g., teleconsultations) to maintain links between primary care and reference centers, and (2) creating new roles between hospitals and primary care, such as community nurses, community pharmacists, hospitalists, or primary care doctors specialized in chronic disease management.

Overall, the study highlights the importance of involving patients in care design, especially for complex chronic diseases, by empowering them and their families with essential information. A next step in research could be to examine whether an integrated approach also reduces healthcare service usage (emergency visits, hospital admissions, diagnostic tests, and outpatient visits), potentially leading to long-term savings for the healthcare system.

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