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General supply chain and healthcare supply chain specificities, as well as outpatient path management in Hungary

The healthcare supply chain differs significantly from industrial supply chains due to its focus on human life and health. This necessitates time-sensitive, high-quality, and traceable logistics. It involves multiple stakeholders—manufacturers, distributors, providers, and patients—making it inherently complex. To improve efficiency and resilience, innovative solutions are required. The goal is to offer actionable strategies for a more effective, transparent, and equitable healthcare system. Emphasis is placed on digital tools to address structural issues and enhance care delivery. The study examines digital approaches such as blockchain, automation, and data-driven decision-making. Blockchain enhances traceability and authenticity, while automation improves inventory control and reduces errors. In Hungary, the system struggles with underfunding, workforce shortages, and regional disparities. Digital initiatives like EESZT aim to improve coordination, yet challenges like low digital literacy persist. The COVID-19 pandemic highlighted global supply chain vulnerabilities but also accelerated digital transformation. The study focuses on Hungary's unique challenges, integrating theory and data to uncover inefficiencies and propose improvements. Findings confirm that modern technologies can significantly improve healthcare quality and sustainability.
Keywords: Healthcare supply chain; Innovation; Blockchain technology; Electronic Health Service Space (EESZT); Outpatient management system
JEL code: I18, L14, L22, O33, R53

https://doi.org/10.32976/stratfuz.2025.17

Introduction

The concept and importance of the supply chain have garnered increasing attention in global economic and social discourse in recent decades. This complex system spans from the procurement of raw materials to the delivery of the final product to the consumer, and optimizing the various stages fundamentally determines the success of economic actors. The traditional goal of the supply chain has been to minimize costs, increase customer satisfaction, and maintain competitiveness, but in the healthcare sector, these priorities take on a new meaning. The healthcare supply chain is not only a logistical challenge but also a critical tool for ensuring human life and health (Haffar & Ozceylan, 2025). The characteristics, complexity, and significance of the healthcare supply chain differ greatly from those of traditional industrial or commercial supply chains. While the primary goal in the business sector is maximizing profit, the focus in healthcare is on saving lives and ensuring the improvement of patients' conditions. The timely and accurate delivery of medical devices, medicines, and other healthcare products to the right place not only increases efficiency but directly impacts patient survival rates and quality of life. Time sensitivity, precision, and traceability are requirements in this sector that define the logistics processes and every segment of the supply chain (Gelei & Gémesi, 2010). Recent events, such as the COVID-19 pandemic, have highlighted the vulnerability of healthcare supply chains and their global significance. The shortages of medical supplies and medicines, along with logistical disruptions during the pandemic, presented challenges to healthcare systems that accelerated the adoption of

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innovative solutions, such as digitalization, blockchain technology, and data-driven decision-making. These innovations not only enhance the efficiency of healthcare supply chains but also contribute to long-term sustainability and resilience. In the healthcare supply chain, innovation is not just a response to problems but also an opportunity to establish a new foundation for the healthcare system (Tisóczki, 2022; Webster, 1995). Modern technologies, such as artificial intelligence, automation, and blockchain, are capable of increasing transparency, speed, and accuracy in the supply chain. The application of cold chain technology ensures the preservation of time-sensitive medicines and vaccines, which is crucial for public health. Improving traceability helps reduce the circulation of counterfeit drugs, which brings not only economic but also direct health benefits. In Hungary, the healthcare supply chain and outpatient care management face particularly significant challenges. Underfunding, shortages of specialist and skilled staff, and inequalities in digital infrastructure all hinder the effective functioning of the system. The introduction of the outpatient management system and the Electronic Health Service Space (EESZT) are steps aimed at improving the coordination and transparency of care. However, these measures still require significant development to fully realize the potential of the system. Capacity shortages and long waiting lists in Hungary's healthcare system are also critical problems. These difficulties are especially severe in rural areas, where access to medical care is often limited. To improve the situation, not only infrastructural development is needed but also support for workforce training and retention. E-health, such as telemedicine, can reduce territorial inequalities in the healthcare system while increasing the speed and quality of patient care (Hattayer & Gál, 2022; Min, 2016, 2017). This study seeks to answer the research question of how the healthcare supply chain—and thus the efficiency of care—can be improved, following the example of supply chains operating efficiently in other sectors. It can be hypothesized that automations and innovations that have already been successfully used elsewhere would also positively influence the efficiency of healthcare. The study is structured to provide a comprehensive analysis of the healthcare supply chain through both theoretical and practical lenses. It begins with a presentation of general concepts and theoretical foundations of supply chain management, offering insights into its significance across various sectors. Following this, the peculiarities of the healthcare supply chain are explored in depth. The paper then reviews examples of innovations and technologies—such as automation, digitalization, and blockchain—from other industries that could be applicable in healthcare. Finally, the findings are synthesized to offer concrete recommendations for the implementation of these tools in healthcare, with particular attention to the Hungarian context.

Materials and methods

Comparing general and healthcare supply chains addresses a significant gap in understanding and health policy development. Learning from mature systems in other sectors helps avoid early-stage mistakes and reveals sector-specific needs in healthcare. This study uses a theoretical and analytical methodology focused on Hungary's outpatient care and patient pathway optimization. It combines literature review, documentary analysis, and statistical data from sources such as the Hungarian Central Statistical Office (KSH) and OECD to provide a multidisciplinary perspective that includes logistics, technology, and policy. The research outlines the theoretical application of supply chain management (SCM) in healthcare, with special attention to innovations like blockchain, automation, and digitalization for improved efficiency. Comparative analysis highlights key differences between general and healthcare supply chains—such as cost-efficiency versus patient-centered care—and stresses the need for precision, traceability, and regulatory compliance. Hungary's Electronic Health Service Space (EESZT) and outpatient system are analyzed as case studies, with attention to digital literacy, workforce shortages, and regional disparities. The study evaluates the potential of technologies like AI, blockchain, and e-health to improve transparency and efficiency, particularly in rural areas and during crises like COVID-19. Based on this analysis, recommendations include increasing funding, enhancing digital

infrastructure, and investing in workforce training to optimize Hungary's healthcare supply chain. The integrated methodology offers a comprehensive view of operational dynamics and supports sustainable healthcare delivery.

Results and discussion

This part of the "Results and Discussion" chapter will focus on the analysis of statistical data, with particular emphasis on healthcare expenditures and resources in OECD countries, especially Hungary. The chapter presents how Hungary significantly lags behind other developed or neighboring countries in terms of healthcare spending as a percentage of GDP. It also highlights trends in human and infrastructural resources (such as the number of doctors, general practitioners, hospital beds, and pharmacies) over the past decade.This analysis is closely linked to the research objective, which is to explore how the efficiency of healthcare delivery can be improved through developments in logistics and supply chains. The statistical findings support the hypothesis that the current underfunding, workforce shortages, and infrastructural deficiencies pose serious challenges, and reinforce the need for the introduction of innovations (such as digital solutions and automation). The comparative analysis and case examples from other countries, as outlined in the methodological framework, also underpin the quantitative approach taken in this chapter.

Statistical data on healthcare in OECD countries and Hungary's performance

Based on healthcare expenditures as a percentage of GDP, Hungary's position in comparison to other European OECD countries is evident in the statistical data. Healthcare expenditures increased in most countries in 2020, likely due to the extraordinary health needs caused by the COVID-19 pandemic. After 2021, a slight decline or stabilization was observed in several countries, although in some, such as Germany and France, expenditures remained at high levels. Hungary's healthcare expenditure as a percentage of GDP is among the lowest in European countries. Expenditures started at 6,9% in 2015, peaked at 7,3% in 2020, and then decreased to 6,4% by 2023. This is lower than neighboring countries, such as Austria and Slovakia. Switzerland and Germany consistently maintained high expenditure levels (above 11% from 2015 to 2023), reflecting the financing of their advanced healthcare systems. Austria showed a significant increase in 2020 (11,3 and has remained high since. Turkey's expenditures are around 4%, which is far below the European average. Luxembourg also exhibited a low ratio (5-6%), which can be partly explained by the country's small size and unique economic structure. In most countries, a significant increase was observed in 2020, for example, in Canada 13% (the highest value during this period), with France and Germany also showing considerable increases. In Central and Eastern European countries (Czech Republic, Slovakia, Hungary, Poland), healthcare expenditures are lower than in Western Europe. Nordic countries (Sweden, Finland, Norway) maintain higher levels of expenditure than the average. Hungary's healthcare system financing has not been able to sustain the elevated levels during the pandemic. Hungary's lag is especially noticeable when compared to Austria, where expenditures reach 11-12% of GDP. Increasing healthcare spending is essential in Hungary, particularly for post-pandemic recovery and long-term sustainability. Comparing with neighboring countries can help adopt best practices. In terms of Hungary and its neighboring countries, Hungary's GDP-based healthcare expenditures remained among the lowest in comparison to its neighboring countries during the examined years. Austria consistently stood out in the region with the highest healthcare expenditures. Slovakia and the Czech Republic showed significant growth in 2020, but this declined by 2023. (Figure 1)

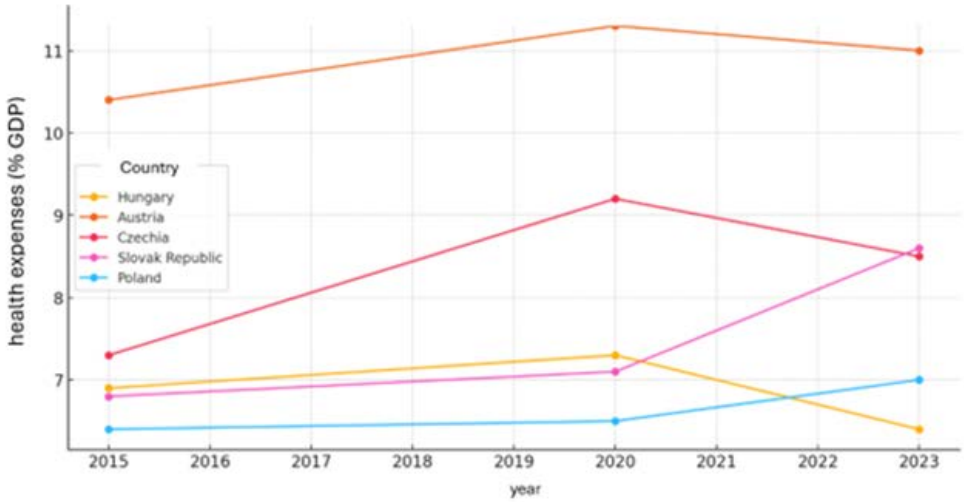

Figure 1: Trends in healthcare expenditures (% of GDP) Hungary and neighboring
Source: based on OECD data, own editing

Based on the data from Source OECD database Health expenditure and financing for 2015, 2020 and 2023, the highest average expenditures were recorded in Germany, France, Canada, Switzerland and Belgium. These five most economically developed European countries consistently showed GDP-based expenditures above 11%, indicating the financing of advanced health systems. Also, based on the data from Source: OECD database Health expenditure and financing 2015, 2020 and 2023, Hungary is among the five countries with the lowest average budget, along with Luxembourg, Ireland, Poland and Turkey. This highlights the underfinancing of the Hungarian healthcare system in an international context. These five least economically developed European countries consistently showed GDP-based expenditures below 7%, which falls significantly short of the financing of advanced healthcare systems. (KSH.hu)
According to data from the Hungarian Central Statistical Office (KSH), healthcare expenditures and indicators of the healthcare system in Hungary have shown fluctuating trends between 2012 and 2022. The ratio of healthcare expenditures to GDP was 7,4% in 2012, which decreased to 6,3% by 2019. Afterward, it jumped to 7,3% in 2020, likely due to the extra healthcare burdens associated with the COVID-19 pandemic, but it again decreased to 6,7% by 2022. (Figure 2)

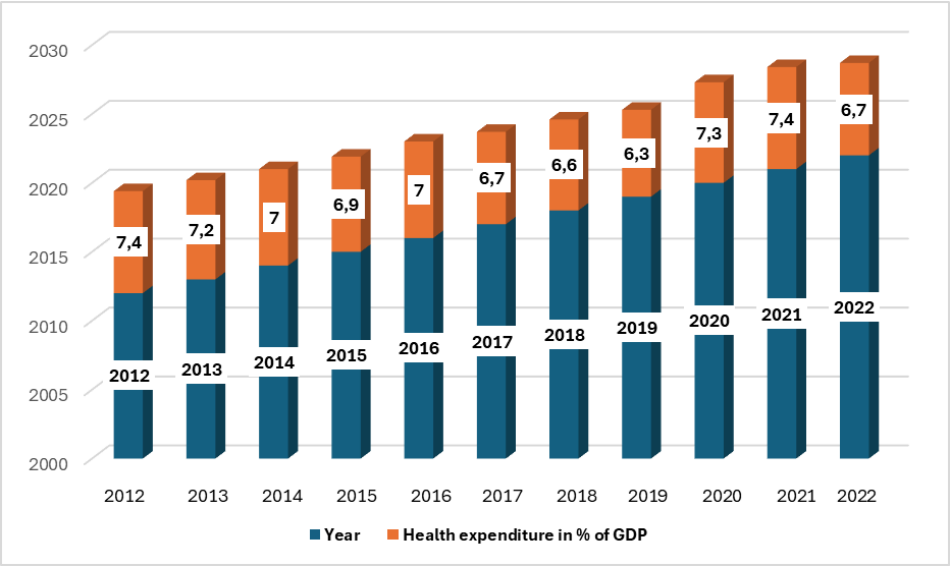

Figure 2: The proportion of healthcare expenditure in relation to GDP in Hungary
Source: based on ksh.hu, own editing

The number of doctors has overall increased, from 36,250 in 2012 to 40,671 in 2022. However, this growth has not been uniform: for example, in 2020, there was a decline (to 37,188 doctors), which may also be linked to the system strain caused by the pandemic and other factors. The number of general practitioners showed a declining trend, from 6,415 in 2012 to 5,748 in 2022. This is a concerning decrease, which has increased the number of residents per doctor (from 1,545 to 1,670).The number of operational hospital beds steadily decreased between 2012 and 2022, from 68,845 to 65,541. This is likely related to the rationalization of healthcare infrastructure, possibly linked to capacity management during the pandemic.The number of public pharmacies slightly decreased (from 2,331 to 2,277), but the number of pharmacists increased, from 5,679 to 6,349. This can be viewed as a positive development for pharmaceutical care. Among the positive trends, the increase in the number of doctors and pharmacists, as well as the improved ratio of pharmacists, suggests progress in human resources. Challenges in the sector include the decline in the number of general practitioners, the reduction in the number of hospital beds, and the decrease in healthcare expenditures relative to GDP—issues that may pose long-term challenges for the healthcare system. The significant data from 2020-2021 highlight the strain that the COVID-19 pandemic placed on resources. (Figure 3,4)

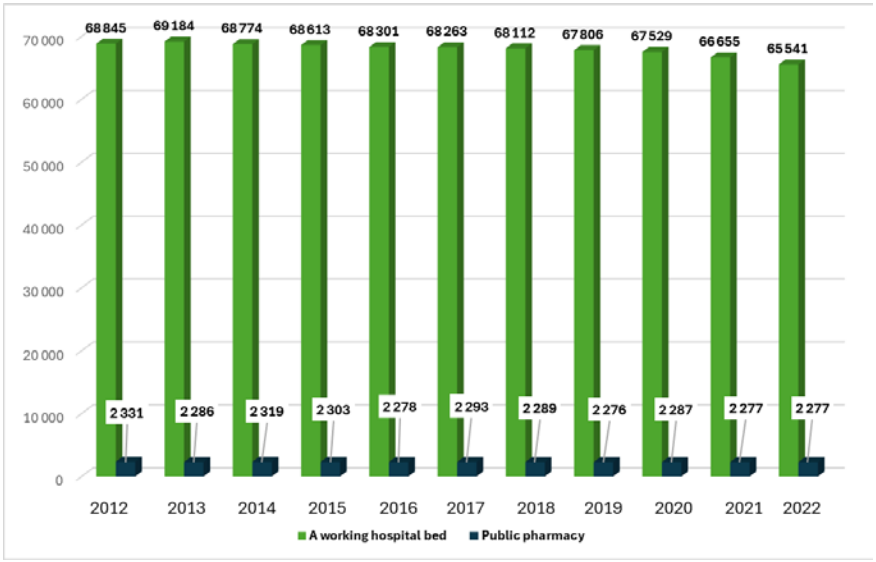

Figure 3: Analyses for healthcare sectors 2. / measured in units
Source: based on KSH.hu, own editing

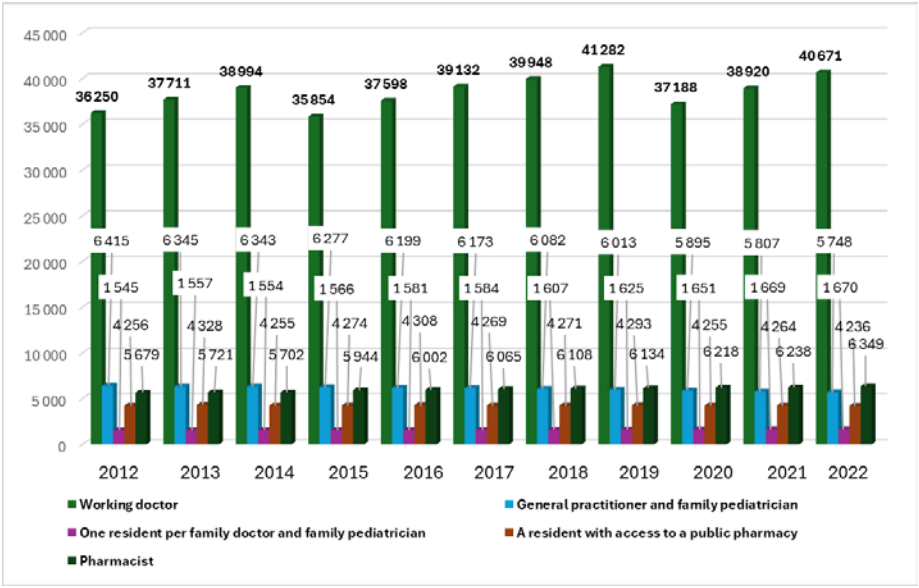

Figure 4: Analyses of healthcare sectors 1. / in number
Source: based on KSH.hu, own editing

Analysis of supply and healthcare supply chain management

The supply chain is a complex system involving multiple actors and processes, ranging from raw material procurement to the delivery of the final product to the consumer. It is generally divided into five main stages: procurement of raw materials, manufacturing, storage, distribution, and serving the end consumer. The efficiency of the supply chain is crucial for reducing costs, increasing customer satisfaction, and maintaining competitiveness. Modern technologies such as automation, artificial intelligence, and data-driven decision-making have significantly contributed to optimizing traditional supply chains (Haffar & Ozceylan, 2025). The healthcare supply chain

is one of the most essential pillars of healthcare system operations. Its task is to ensure the seamless availability of necessary tools, medications, equipment, and other healthcare services for patients. Analyzing the supply chain is particularly important because its efficiency directly affects the quality of patient care, resource utilization, and cost optimization (Gelei & Gémesi, 2010; Kastor, 2003).

Principles of general supply chain and healthcare supply chain management

The goal of supply chain management is to ensure the efficient and transparent flow of materials, information, and financial resources from suppliers to end-users. Effective SCM is based on five distinct key elements: planning, procurement, manufacturing/distribution, logistics/storage, and feedback. The following table illustrates the comparison of the key elements of the general and healthcare supply chain. *(Table 1)* Each process builds on the previous one, forming a chain, although they consist of well-differentiated parts. However, the processes and the resources required for them must be optimized. An essential condition for cost-effective operation is that raw materials and products are procured at the right price and quality and that the finished product reaches customers most shortly and cost-effectively. One of the foundations for increasing efficiency is customer feedback and satisfaction measurement. The healthcare supply chain is a highly complex and multi-layered system, with processes differing only in the first and last steps. While the first element in a general supply chain is planning and the last is feedback, the first element in the healthcare supply chain is procurement, and the last is distribution and use. The successful application of SCM in industries like automobile manufacturing, electronics, or retail has served as a model for the development of healthcare supply chain management (Gelei & Gémesi, 2010; Kastor, 2003).

Table 1: Comparison of Key Elements of General and Healthcare Supply Chains

Process	**General supply chain description**	**Healthcare supply chain description**
Planning	Optimization of processes and resources within the supply chain	
Sourcing	Ensuring materials and products are sourced at appropriate quality and cost.	Procuring necessary raw materials and finished products, such as medicines, medical instruments, and disinfectants, focusing on quality, price, and reliability of suppliers
Manufacturing & Distribution	Production of goods and delivering to customers as quickly and cost-effectively as possible	Meeting strict standards and regulations, such as pharmaceutical manufacturing where precision and sterile conditions are essential
Logistics & Warehousing	Movement, storage, and transportation of goods along optimal routes	Special storage and transportation conditions for products like vaccines, requiring refrigeration or freezing (cold chain)
Feedback Distribution/Usage	Monitoring customer needs and implementing continuous improvements	Distribution to healthcare institutions (hospitals, clinics, pharmacies) where products are used for patient care

Source: own editing

The principles of healthcare supply chain management are similar to those of general SCM, but the implementation methods differ significantly, as in healthcare, the primary goal is the life and well-being of patients. Healthcare supply chain management (HSCM) focuses on the timely procurement and distribution of medications, medical devices, protective equipment, and other healthcare products (Gelei & Gémesi, 2010).

Aspects of healthcare supply chain analysis

When analyzing the healthcare supply chain, several factors must be considered that directly impact the system's efficiency. One of the most important aspects is the cost-effectiveness of the supply chain, which is especially critical due to the sector's underfunding. To minimize costs, analysis must be conducted in areas such as inventory management and the optimization of transportation routes. Excessive inventory can lead to waste, while stock shortages can cause supply disruptions. Disruptions in global supply chains, such as pandemics or geopolitical conflicts, often cause stock shortages. Determining the optimal inventory level is essential. By increasing the efficiency of logistics processes, transportation costs and delivery times can be reduced. In rural areas, the supply chain is often less efficient, which creates disadvantages for patients living there. The quality of healthcare products directly affects patient health. Therefore, the analysis must ensure that strict quality assurance procedures are applied at every stage of the supply chain. Another critical aspect is risk management. Disruptions in the healthcare supply chain—such as the stock shortages experienced during the COVID-19 pandemic—carry significant risks. During the analysis, potential risks that may arise at any stage of the supply chain should be identified, and strategies for managing these risks should be determined. Furthermore, managing the large volume of data generated by the supply chain presents challenges, particularly in terms of protecting patient data. Another crucial part of the analysis is exploring the potential for technological advancements. The use of electronic data interchange (EDI), supply chain management systems (SCMS), artificial intelligence, and blockchain technology can contribute to increased transparency and efficiency. Sustainability considerations, such as eco-friendly packaging, energy-efficient transportation, and waste management, must also be taken into account during supply chain analysis (Tisóczki, 2022; Webster, 1995).

Challenges and development opportunities in the healthcare supply chain

The healthcare sector faces specific challenges, including underfunding, stricter regulatory environments, and managing pandemics and other crises. The pandemic, for instance, highlighted the importance of the supply chain’s flexibility and sustainability, as worldwide shortages of essential tools, medicines, protective equipment, and ventilators emerged (Hattayer & Gál, 2022). Innovations like blockchain technology enable tracking every element of the supply chain, reducing the circulation of counterfeit drugs and improving system transparency (Vazquez Melendez et al., 2024). Based on the analysis, several development opportunities have been identified that could improve the functioning of the healthcare supply chain. Digitalization and automation, including data-driven decision-making and the introduction of automated processes, can increase efficiency and transparency. The use of blockchain is another development opportunity, ensuring data authenticity and preventing counterfeit products, especially in the pharmaceutical sector. Environmentally friendly transportation solutions, recyclable packaging, and energy-saving technologies are also important development points and are crucial from a sustainability perspective. In healthcare, efficient medicine distribution—ensuring the accurate and rapid delivery of pharmaceuticals—is of paramount importance. While pharmaceutical companies already place great emphasis on efficient patient care, another development point could be the use of smaller, local warehouses, which could reduce delivery times and increase flexibility (Min, 2016, 2017).

The relationship between supply chain management and healthcare supply chain management

The relationship between Supply Chain Management (SCM) and Healthcare Supply Chain Management (HSCM) is based on several common principles and practices; however, significant differences exist between the two fields, stemming from their different objectives and priorities. One of the most notable differences lies in the goals of the two types of supply chains: while traditional supply chains aim to maximize profit, the primary objective of the healthcare supply chain is to ensure the health and well-being of patients. In healthcare, logistics processes focus on the fast and reliable delivery of medical devices, pharmaceuticals, diagnostic tools, and other vital supplies. Precision and timing are crucial in this sector, as certain products, such as vaccines, medications, and blood products, are highly time-sensitive and require specific storage and transport conditions. Healthcare supply chains often involve cold chain systems, which incorporate temperature-controlled logistics. Transparency, traceability, and collaboration are also critical factors. (Gelei, 2003; Muhammad et al., 2010)Another fundamental difference lies in the priorities. In a general supply chain, cost efficiency and profitability are the primary goals, whereas in healthcare, timing, accuracy, and quality take precedence. A delay in the delivery of a medical device or medication can even result in the loss of life. There is also a difference in product sensitivity. Healthcare products such as vaccines, blood products, or certain medications require special storage and transport conditions, such as refrigerated environments (cold chain). In contrast, most goods in traditional supply chains are less sensitive to weather or storage conditions. Risk management and regulation are also key considerations. In healthcare, stockouts or product deterioration can have immediate and severe consequences, making risk management stricter and more complex. The procurement and use of healthcare products are subject to strict regulations (e.g., quality certifications, and permits), which are less pronounced in other industries. (Fetter, 2019; Min, 2017)

Challenges and opportunities in integration

One of the biggest challenges in the relationship between SCM and HSCM is aligning their differing priorities. While cost reduction is a key focus in SCM, in healthcare, patient interests take precedence, often leading to additional costs. However, strengthening the relationship between the two systems offers numerous opportunities. Traditional SCM solutions, such as automated warehouse management or technologies ensuring supply chain transparency, can contribute to increasing the reliability of healthcare services. Enhancing the flexibility of the healthcare supply chain (for example, in crises) can be made more efficient by adopting best practices from SCM. (Handfield & Bechtel 2002; Langabeer et al. 2016)

The relationship between international and domestic healthcare supply chain management

Healthcare supply chain management is a fundamental pillar of the functioning of both global and national healthcare systems. The international and domestic supply chains are closely interconnected, as domestic systems rely on foreign suppliers, technologies, and pharmaceuticals, while international systems must adapt to local needs. Analyzing this relationship is particularly important because, with globalization, the mutual dependence between countries increases, while the need to maintain local-level flexibility remains essential. (Ellram et al., 2004) The international supply chain ensures that different countries have access to the latest technologies, medicines, and equipment. The global healthcare industry plays a significant role in shaping the operation of domestic supply chains. Regarding the procurement of medicines and medical devices, most countries, including Hungary, heavily depend on international pharmaceutical manufacturers and medical technology companies. Leading global manufacturers, such as the United States, Germany, China, and India, play a critical role in the global pharmaceutical supply chain. In research and innovation, international research and development collaborations make the latest

medicines, treatments, and diagnostic tools available worldwide. Hungary, for instance, participates in international clinical trials aimed at developing and testing new drugs. The effects of globalization are significant, as it allows for faster distribution of products, while simultaneously increasing the mutual dependency between countries. This is particularly true for the manufacturing of medicines, vaccines, and medical devices, where the supply of raw materials and products often spans multiple continents. (Király et al., 2023) Recently, especially since the COVID-19 pandemic, emergency and humanitarian aid has received greater emphasis. International cooperation is essential in managing pandemics, natural disasters, and other crises. During the COVID-19 pandemic, for example, international supply chains played a key role in the rapid distribution of vaccines, protective equipment, and ventilators. (Hattayer & Gál, 2022) Hungary's healthcare supply chain operates integrally with international systems but faces several unique challenges and characteristics. Hungary has a strong domestic manufacturing capacity in certain areas, such as the production of generic medicines, but in many instances, it heavily depends on international suppliers for raw materials and finished products. This dependency can create critical situations in the event of global supply disruptions. The domestic logistics network often struggles to meet international expectations. Rural healthcare facilities may experience supply difficulties, leading to regional disparities in the quality of care. To comply with international regulations, Hungary's regulatory system continuously aligns with the European Union and other global standards, facilitating the availability of quality products but also increasing procurement and operating costs. Increasing emphasis on digitalization and automation in domestic healthcare institutions is facilitating integration with international supply chains. The introduction of electronic data management systems enhances transparency and inventory management. (Fetter, 2019) The relationship between international and domestic healthcare supply chains can be observed in several areas. A significant portion of the medicines and equipment used by domestic healthcare institutions comes from international sources. During the procurement of imported products, disruptions in international supply chains, such as shipping delays or raw material shortages, directly affect domestic supply. (Fetter, 2019) The COVID-19 pandemic highlighted the risks associated with the mutual dependency between international and domestic supply chains. For example, in the procurement of vaccines and protective equipment, the capacity of international manufacturers and the state of global shipping routes were decisive for domestic distribution. (Ertugrul & Kozma, 2021) Through collaboration with international companies, Hungary gains access to advanced technologies and know-how, which can significantly improve the efficiency of the domestic supply chain. This is especially true for diagnostic tools and innovative medicines. International regulations and expectations impact the sustainability of domestic supply chains. The European Union, for instance, has introduced stringent regulations on environmentally friendly packaging and transportation, which are also mandatory for Hungarian suppliers and manufacturers. (Hausmann, 2020) Expanding domestic manufacturing capacity could reduce import dependency and increase flexibility. This would be particularly important for essential medicines and protective equipment. Closer collaboration with international organizations and manufacturers could facilitate faster access to critical products. The use of digitalization and artificial intelligence could improve supply chain transparency and efficiency at both international and domestic levels. Coordinating global and local emergency supply strategies would enable faster and more efficient responses. (Bokor, 2005; Rawabdeh, 2024)

Outpatient care and patient pathway management in Hungary

Outpatient care is a key component of Hungary's healthcare system. It refers to healthcare services where patients do not require inpatient care but receive ambulatory, complex diagnostic, and treatment through specialist consultations or minor interventions. Patient pathway management aims to ensure the efficient and smooth flow of patients through the healthcare system. In Hungary, patient pathway organization faces significant challenges, such as capacity shortages,

long waiting lists, and uneven geographical distribution of healthcare services. To optimize patient pathway management and primary care, the swift organization of specialist consultations, and the development of information systems play a central role. The development of eHealth, such as telemedicine and the Electronic Health Service Space (EESZT), is an important milestone in care coordination, enabling effective data sharing between doctors, hospitals, and pharmacies. The introduction of the Outpatient Management System in Hungary aimed to increase the efficiency of healthcare services, optimize patient care, and improve transparency and traceability. The system's goal is to provide patients with a clear and seamless pathway between various levels of care, minimizing waiting times, unnecessary examinations, and resource waste. The implementation of the Electronic Health Service Space (EESZT) in 2017 laid a good foundation for this, as it allowed for the centralized storage and sharing of patient data between healthcare providers. However, the system's introduction encountered several challenges. One of the biggest difficulties was the shortage of human resources, especially among specialists and skilled staff. This led to long waiting lists, which hindered prompt patient management. Additionally, due to the regional disparities in healthcare infrastructure, access to high-quality specialist care is challenging in rural areas. From a technological standpoint, the implementation of the Outpatient Management System was not smooth, as many institutions lacked the necessary IT systems and tools. The lack of digital skills required for using the system further slowed the process, particularly among older healthcare workers. For patients, understanding and accepting the new system posed a challenge, especially for older generations less familiar with digital technologies. Despite the obstacles in implementation and the fact that full development is still ongoing, the outpatient management system can bring fundamental positive changes. However, the proper allocation of resources, infrastructure development, and further digitalization is crucial for the system to fully achieve its goal: making patient care faster, more efficient, and fairer. (Falus & Kiss, 2019; Horvath, 2017; Kelen & Kovács, 2024)

Discussion

Analyzing the healthcare supply chain is essential for increasing the efficiency, reliability, and sustainability of healthcare services. The application of modern technologies, the development of risk management strategies, and the reduction of regional disparities can help ensure that healthcare is accessible to all patients promptly and with the appropriate quality. The results derived from supply chain analysis not only promote the improvement of patient care but also contribute to long-term cost-effectiveness. The relationship between supply chain management and healthcare supply chain management offers opportunities to enhance industry efficiency if general logistics methods are adapted to the specific requirements of the healthcare sector. The integration of the two fields is crucial to ensuring high-quality patient care, particularly with the application of modern technologies and data-driven solutions. The development of the healthcare supply chain thus not only improves the quality of medical care but also supports the sustainability of healthcare systems in the long term. The general model of the supply chain and the differences between the healthcare supply chain highlight the varying priorities and requirements of the sectors. In healthcare, preserving human life and ensuring patient well-being is paramount, which carries a significant responsibility and requires precision. In Hungary, the development of outpatient care and patient pathway management is key to increasing system efficiency and improving patient satisfaction. The application of IT solutions and modern logistics principles is essential for sustainable and successful healthcare delivery.

Conclusion

The complexity of modern healthcare supply chains and patient journey management not only highlights the opportunities for technological advancements, but also highlights fundamental societal challenges. Innovations such as blockchain technology and automation can increase the

transparency and efficiency of healthcare, thereby improving its quality. However, real breakthroughs can only be achieved if technological developments are implemented in line with human factors and infrastructure development. In the case of Hungary, reducing inequalities between rural and urban healthcare systems, as well as training and retaining human resources, are of critical importance. While digitalization alone cannot eliminate regional inequalities, a well-designed strategy can significantly mitigate their impact. The introduction of outpatient management systems and the Electronic Health Service Space (EESZT) can improve the sustainability and accessibility of the healthcare system in the long term, provided that these systems are further developed in line with societal needs and with the involvement of stakeholders. Overall, optimizing supply chains, integrating modern technologies, and ensuring transparent and equitable patient pathways are essential for building a more competitive and just healthcare system. It can therefore be stated that the hypothesis posed at the beginning of the study is acceptable and, according to this, automations and innovations already successfully applied in other sectors would also positively influence the efficiency of healthcare.

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