A Systematic Literature Review: Exploring Healthcare Supply Chain Risk Management, Resiliency and Future Research Implications

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Abstract

This paper reports the findings of a systematic literature review examining supply chain risk management (SCRM) and resilience in healthcare supply chains. The review used thematic analysis (manually constructed themes with the help of each article's highlights to identify shared insights and trends across the literature.)to identify trends and gaps within the existing literature. The findings reveal three critical research gaps in the literature. Firstly, there needs to be more research on rural healthcare supply chains despite ample studies on innovations and data sharing for enhancing supply chain resilience. This underscores a research gap in understanding the unique challenges rural healthcare settings face. Secondly, the potential of A.I. algorithm-based systems in enhancing supply chain resilience in healthcare remains underexplored, indicating a need to explore the role of A.I. in healthcare supply chains. Finally, integrating supply chain management with Lean Six Sigma practices for enhancing supply chain resilience requires more research for broader industry applications despite its theoretical importance. The study also identified vital thematic areas crucial to enhancing supply chain resilience in healthcare settings, such as technology, innovation, data sharing, Lean Six Sigma, supply chain management, and A.I. algorithm-based systems. Identifying these themes provides a foundation for future research and practical implications for healthcare organizations to adapt to unexpected disruptions and improve their supply chain resilience.

Keywords
Supply Chain, Risk, Network, Healthcare.

1. Introduction

Supply chain risk management (SCRM) is an evolving field that has gained much attention over the years. Since its emergence in the early 2000s, significant contributions, such as Norrman and Jansson's seminal work in 2004, have extensively defined SCRM and proposed measures for identifying and mitigating supply chain risks (SCRs). However, the term "resilience" has several meanings and changes based on the topic or industry. In the supply chain industry, particularly healthcare, resilience involves delivering products as expected despite unexpected disruptions (Bahadori et al., 2017; Polater & Demirdogen, 2018). This resilience is an integral part of risk management. A resilient healthcare supply chain can withstand disruptions, adapt quickly to changing circumstances, and recover rapidly from unexpected events. However,. In the last few years until COVID-19, despite valuable insights provided by such studies on the healthcare supply chain risk management, these studies have had limited scope in effectively discussing overall resilience and immunity within the supply chain risk management ecosystem of healthcare.

However, the COVID-19 pandemic called attention to the need for overall resilience in healthcare supply chain risk management. In the recent articles, the pandemic emerged as an unforeseen and perilous development in 2020, significantly challenging the healthcare system and disrupting supply chains (Ivanov, 2020 & Senna et al., 2021).

Moreover, similar studies highlight the importance of a comprehensive approach to supply chain risk management in the healthcare sector to improve supply chain resilience. For instance, Kim et al. (2018) argue that effective risk management strategies are crucial for identifying and mitigating potential risks to prevent supply chain disruptions that could adversely impact the healthcare supply chain's performance. Similarly, Fahimnia et al. (2015) identify supply chain flexibility and agility as key components for healthcare supply chain resilience. Tiong et al. (2016) investigate the impact of supply chain resilience on organizational performance in the healthcare industry. The above-mentioned collection of studies illustrates the intrinsic connection between risk management, supply chain management, and resilience within healthcare supply chains. It emphasizes the imperative for healthcare organizations to implement effective risk and supply chain management strategies, mitigating disruptions and enhancing SCRM resilience.

Organizations prioritize enhancing resilience in their global supply chain through efficient strategies in supply chain risk management. This involves identifying potential high-risk factors, analyzing their impact, and devising strategic measures for risk mitigation. Additionally, organizations conduct due diligence in formulating incident response and recovery plans to ensure continuous business operations and prevent disruptions in the supply chain.

Critical components of this risk management plan include fostering risk awareness, incorporating technology for enhanced supply chain visibility, diversifying providers, and establishing flexible logistics options. It is essential to train personnel and conduct simulations to adequately prepare the organization for the implementation of the risk management plan in response to a risk event. The paper delves into strategies and different dimensions of SCRM for enhancing overall resilience, highlighting the necessity for swift recovery, adaptability, and effective disruption endurance in supply chain risk management.

 The aim of this systematic literature review is to explore healthcare supply chain risk management (SCRM), its resiliency, and future implications. The objectives are to Analyze the different dimensions of healthcare SCRM and their impact on the resilience of supply chains in terms of unexpected disruptions, such as the COVID-19 pandemic. Evaluate existing studies to identify gaps in knowledge about SCRM resiliency in healthcare and to determine areas requiring further research. Synthesize the current literature on healthcare SCRM and its resiliency to develop meaningful insights and recommendations for future researchers.

2. Literature review
The selected articles are divided into the following themes, constructed themes with the help of each article's highlights to identify common insights and trends across the literature.

2.1 Supply Chain Visibility and Information Sharing
 One of the most critical factors for SCRM resiliency in healthcare is the visibility and transparency of the supply chain. Greater visibility allows real-time access to information that can be used to manage risks more effectively. This theme examines the existing literature and research gaps related to the need for greater visibility and information sharing among S.C. partners in healthcare. The literature review could analyze how collaboration and data sharing among supply chain partners could contribute to increasing healthcare supply chain efficiency and resilience. It focuses on transparency, monitoring, and collaboration among supply chain stakeholders

2.2 Use of Technology for SCRM Resilience
 Emerging technologies such as blockchain, IoT, and artificial intelligence have the potential to revolutionize how healthcare organizations approach SCRM resiliency. This theme explores the existing literature and research gaps related to the use of these technologies to enhance SCRM resiliency in healthcare. By reviewing the literature on the use of these technologies, the theme identifies best practices, evaluates the effectiveness of different technologies, and analyzes the limitations and challenges of adopting these technologies in healthcare.

2.3 Innovative Logistics and Inventory Management for SCRM Resilience
 Logistics and inventory management play a crucial role in SCRM resiliency in healthcare. Efficient and agile logistics and inventory management practices help healthcare organizations respond effectively to supply chain disruptions. This theme explores new and innovative methods of logistics and inventory management that can contribute to SCRM resiliency in healthcare. By reviewing the literature in this area, the theme tries to identify gaps in current logistics and inventory management practices and suggests future research directions.

2.4 Data Quality and Analytics

Accurate and timely information is crucial for effective SCRM resiliency practices. It focuses on the accuracy, reliability, and analysis of the data obtained from the supply chain.

The above themes are all essential components to achieve your research objective of conducting a systematic literature review of healthcare supply chain risk management, its resiliency, and future research implications. They contribute unique perspectives on SCRM resiliency in healthcare and reflect the interconnectivity of different factors that contribute to healthcare supply chain management. A Small chunk of pertinent articles is listed in Table 1.

Table 1. A Small chunk of pertinent articles

Authors	Research aim	Data collection method
Marrone, P.V., Mathias, F.R., Bernardo, W.M., (...), Pereira, S.L., Dias, E.M.	To scope findings in academic literature related to decision criteria for guiding national policy decisions for the Partial Nationalization of the Pharmaceutical Supply Chain (PNPSC) from the viewpoints of three main stakeholders: industry, payers (government and health insurance), and patients.	The study conducts a scoping review of 115 peer-reviewed studies to identify decision criteria and sub-criteria for local manufacturing decisions in the context of PNPSC. The main data analysis tools applied include weighting, decision-making, risk assessment, and forecasting.
Bassiouni, M.M., Chakrabortty, R.K., Hussain, O.K., Rahman, H.F.	The research aim of this study is to propose Deep Learning (DL) approaches for mitigating shipment risks during the COVID-19 pandemic by predicting whether a shipment can be exported from one source to another despite the restrictions imposed by the pandemic.	The study does not involve the collection of empirical data. Instead, the study proposes DL approaches for mitigating shipment risks during the COVID-19 pandemic by predicting whether a shipment can be exported from one source to another despite the restrictions imposed by the pandemic.
Kumar, S., Mallipeddi, R.R.	To identify possible future research directions that production and operations management (POM) researchers can undertake to help organizations, supply chains, and governments develop robust strategies for reducing the number of cyberattacks and their impacts in the age of Industry 4.0 and Industry 5.0.	The study primarily uses an extensive literature review approach to identify possible future research directions on cybersecurity in the context of production and operations management (POM). The study reviews research papers to identify potential avenues for research in domains such as global operations strategy, healthcare operations management, public policy, management of technology, supply chain management, and disruptive technologies.
Spieske, A., Gebhardt, M., Kopyto, M., Birkel, H.	To investigate procurement-related strategies to improve medical supplies availability and strengthen supply chain resilience in the healthcare supply chain (HCSC) during disruptions such as the COVID-19 pandemic.	The study involves conducting semi-structured interviews with 39 procurement and supply chain management experts to derive seven propositions on buffering and bridging approaches for managing evolving resource dependencies in the HCSC and strengthening supply chain resilience.
Handfield, R., Apte, A., Finkenstadt, D.J.	To propose a new type of capability called supply chain immunity that is required to address slow-moving, persistent and dispersed pandemics similar to COVID-19 in the future.	The study adopts an inductive observational approach of engaged scholarship based on the authors' team's extensive involvement in the national COVID-19 healthcare response during March- June 2020.

Ahmadi, E., Mosadegh, H., Maihami, R., (...), Sun, M., Süer, G.A.	This study aims to develop intelligent inventory management (IIM) approaches for managing perishable pharmaceutical products in a healthcare supply chain consisting of multiple regional hospitals and a central warehouse.	The study uses computational methods to compare the performance of the IIM policies to the R,s, and S policies through many test instances. The study uses reinforcement learning methods, explicitly Q-learning and Deep Q-network, to construct IIM policies that provide hospitals with near-optimal order quantities and remaining life distributions for products they order.
Kumar, R., Sharma, S., Vachhani, C., Yadav, N.	This study aims to examine the impact of the ongoing COVID-19 pandemic on cybersecurity in the healthcare sector.	The data collection method of this study involves using classical information retrieval techniques to analyze more than twenty thousand documents for cyber content related to healthcare cybersecurity. The authors build a literature corpus through a keyword search process on scholarly and non-scholarly platforms filtered through 2010-2021.
El Mokrini, A., Aouam, T.	This paper aims to develop a decision-support tool for policymakers to quantify perceived risk and jointly optimize network design and logistics outsourcing.	As this is a conceptual paper, no specific data collection method was employed. The paper instead focuses on discussing the development of a decision-support tool for policymakers to quantify perceived risk and jointly optimize network design and logistics outsourcing in public-private partnerships.
Falasca, M., Dellana, S., Rowe, W.J., Kros, J.F.	This study aims to develop and test a model exploring the relationship between supply chain (S.C.) counterfeit risk management and performance in the healthcare supply chain (HCSC).	The study uses partial least squares structural equation modelling (PLS-SEM) and survey data from 55 HCSC managers to test the research hypotheses. The study examines the relationship between HCRO, HCRM, HRMI, HLP, and HOP in the proposed theoretical model. It concludes that HCRO has a significant positive effect on HCRM, while HCRM has a positive impact on HRMI.
Ali, I., Kannan, D.	To advance the knowledge of healthcare operations and supply chain management by utilizing a topic modelling-based literature review to identify the core topics, examine their dynamic changes, and identify opportunities for further research in the area.	The study uses a topic modelling-based literature review to analyze 571 articles published until 25 January 2022 on healthcare operations and supply chain management.
Gilani Larimi, N., Azhdari, A., Ghousi, R., Du, B.	The research aim of this paper is to present a robust multi-phase optimization approach to model a blood supply chain network ensuring efficient blood collection and develop a protective mathematical model with the incorporation of blood perishability, efficient collation centres, multiple-source suppliers, backup centres, capacity limitation, and uncertain demand.	The study uses a GIS-based method and a protective mathematical model with real-world data.
Gonzatto Junior, O.A., Nascimento, D.C., Russo, C.M., (...), Cuminato, J.A., Louzada, F.	To develop an easy-to-use expert system to predict the demand for personal protective equipment (PPE) sets in hospitals during the COVID-19 pandemic	A naive statistical modelling approach that combines historical data, current protocols, and epidemiological data to build predictive models for the demand for PPE in Brazilian hospitals.

Pourreza, S., Faezipour, M., Faezipour, M.	This study proposes Eye-SCOR, a SCOR-based framework to evaluate the effectiveness of smartphone-based eye status monitoring apps and improve the overall performance of the supply chain network of smart eye/vision monitoring systems, using system dynamics modelling.	The authors use system dynamics modelling to design the Eye-SCOR framework, which includes interaction/activities between the main players and enablers in the supply chain network, cash, and information flow.
Kioskli, K., Dellagiacoma, D., Fotis, T., Mouratidis, H.	The research aim of this study is to explore the supply chain of a Living Lab, which is a community-based organization that adopts co-creation as its primary approach for the development and validation of innovative tools and methodologies and to identify its security and privacy challenges and vulnerabilities.	The study uses the SecTro tool and follows the Privacy-by-Design approach to provide a thorough analysis of the security and privacy challenges and vulnerabilities in the supply chain of a Living Lab. The authors explore the supply chain of a Living Lab and identify the security and privacy issues associated with it.
Hossain, N.U.I., Fazio, S.A., Lawrence, J.-M., (...), Jaradat, R., Alvarado, M.S.	The research aim of this study is to develop a novel framework based on theories and concepts in the systems engineering and supply chain resilience domains to enhance resilience implementation capabilities.	The data collection method employed in this study is a Grounded Theory methodology.
Garcia-Santaolalla, N., de Klerk, K.	The research aim of this article is to propose a joint initiative between the WTO and WHO to create a PPE market supply transparency system that enhances supply chain risk management (SCRM) in the healthcare sector	with an analysis of the global PPE supply chain with a focus on the impact of COVID-19 on PPE production and supply. The authors conduct a literature review to examine the challenges faced by healthcare systems in terms of PPE supply chain management.
Zamiela, C., Hossain, N.U.I., Jaradat, R.	To assess the characteristics of a resilient healthcare supply chain (HCSC) using multicriteria decision-making (MCDM) and rank reversal proximity index.	This study uses a case study approach to examine medical supply chains to identify the key indicators of a resilient healthcare supply chain during the COVID-19 pandemic. Cluster analysis, MCDM, and P.I. analysis are mainly done.
Assi, S., Arafat, B., Abbas, I., Evans, K.	To explore this method's potential to provide a rapid and reliable means of authentication that could help address the issue of counterfeit COVID-19 vaccines.	Measuring a total of 405 COVID-19 vaccine samples, along with their main constituents, using a portable NIR spectrometer. Primarily collected via a laboratory-based spectroscopic method, which allowed for the analysis of the NIR spectra of the samples
Omar, I.A., Debe, M., Jayaraman, R., (...), Omar, M., Arshad, J.	To investigate the potential of blockchain technology as a solution to the lack of information visibility and tracking within the PPE supply chain.	The data were collected via a combination of coding in the Ethereum environment and algorithmic analysis to evaluate the interactions among supply chain stakeholders on the features of blockchain technology in managing supply chain risks and enhancing supply chain resiliency.

Rehman, O.U., Ali, Y.	The research aim is to prioritize resilience strategies for healthcare supply chains while considering the risks that are most severe, probable to occur, and have the lengthiest periods of recovery. The study aims to highlight appropriate resilience strategies for healthcare supply chains that can help address the identified risks.	The data collection method utilized in the study involved assigning importance weights to the criteria for prioritization of risks using the fuzzy analytical hierarchy process.
Bala, R., Sarangee, K.R., He, S., Jin, G.	To identify key supply chain issues that manifest during emergencies and examine the formation of a platform ecosystem to resolve these issues, using a real-life case study of Get Us PPE's response to the COVID-19 pandemic. to examine how the healthcare sector can achieve supply chain resilience during emergencies.	The researchers used the real-life case study to examine the supply chain issues that emerged during the pandemic and how the platform ecosystem was utilized to tackle them.
Lotfi, R., Kargar, B., Rajabzadeh, M., Hesabi, F., Özceylan, E.	The research aim of the study was to improve inventory management in the healthcare sector in the context of COVID-19 conditions by proposing a Resilience and Sustainable Health Care Supply Chain (RSHCSC) with the Vendor-Managed Inventory (VMI) approach using hybrid fuzzy and data-driven robust optimization	involves proposing three Resilience and Sustainable Health Care Supply Chain (RSHCSC) models using a hybrid fuzzy and data-driven robust optimization with a stochastic programming approach, which was used to evaluate the advantages and disadvantages of various inventory management strategies in the healthcare sector during COVID-19 conditions.
Falagara Sigala, I., Sirenko, M., Comes, T., Kovács, G.	Investigate the implementation of blockchain technology in the pharmaceutical supply chain to enhance transparency and traceability. The study aims to identify the potential benefits and challenges of using blockchain technology in the pharmaceutical supply chain and to assess its impact on supply chain risk management (SCRM) and resilience.	The study employs a qualitative research design, using semi-structured interviews to collect data from pharmaceutical industry experts and academics. The authors conduct a literature review on blockchain technology in the pharmaceutical supply chain and use this to develop a framework for analyzing blockchain implementation in pharmaceutical supply chains.
Cannavale, C., Esempio Tammaro, A., Leone, D., Schiavone, F.	To explore the adoption of innovation in inter-organizational healthcare networks and investigate the role of artificial intelligence (A.I.) in improving buyer-supplier relationships to create better performance outcomes.	The study is based on a conceptual approach that proposes theoretical speculations to explore the role of AI-based solutions in managing buyer-supplier relationships and improving performance outcomes in inter-organizational healthcare networks. The authors mainly use existing literature, industry reports, and theoretical explorations of A.I.'s potential in supply chain management to base their speculations.

Tawfik, E.A., Tawfik, A.F., Alajmi, A.M., (...), Babhair, S., Almalik, A.M.	To provide an overview of the current pharmaceutical production system in Saudi Arabia, identify the major challenges faced in diversifying the locally produced pharmaceuticals portfolio and propose remedies to address these challenges.	The researchers collected data by analyzing existing literature, reports, and data sources on the current pharmaceutical production system in Saudi Arabia and related issues.
Hundal, G.S., Thiyagarajan, S., Alduraibi, M., (...), Cudney, E.A., Antony, J.	The research aim is to explore the potential impact of Lean Six Sigma practices on supply chain resilience in the healthcare sector and propose a conceptual framework for achieving resilience in the supply chain through the application of Six Sigma practices.	The researchers used a content analysis method to identify themes from the interview data conducted with 21 participants involved in the healthcare sector.

3. Methods

This research employed a structured approach for data collection and article selection. The Scopus database, renowned for its extensive coverage, is utilized as the primary search engine. The search terms, carefully chosen to align with the research objectives, included key concepts such as 'Health,' 'Risk,' 'Supply,' 'Chain,' and 'Network ", articles published in the year 2013-2023. Two search fields were employed, emphasizing the importance of these terms in exploring literature related to healthcare supply chains, resilience, risk management, and the comparative analysis between traditional and technology-based supply chains. The article selection process involved a meticulous filtration process, incorporating inclusion and exclusion criteria. Initial filtration steps focused on refining the search to articles directly related to the healthcare sector, resulting in a subset of 1410 articles. Further quality assurance measures were implemented on the basis of the inclusion-exclusion criterion. The detailed process is explained below, along with the help of Figure 1.

This paper aims to conduct a deeper exploration of the literature review to identify research gaps and future implications in SCRM resiliency for healthcare. Therefore, the research questions are formulated as follows:

1. *How can supply chain risk management (SCRM) be leveraged to enhance the resilience of healthcare supply chains, especially in the context of unexpected disruptions?*
2. *What gaps exist in these areas that warrant further investigation?*

As Kilubi (2016a) highlights, we make sure that the goals and the research scope are in line by carefully formulating the fundamental research questions. Furthermore, Light and Pillemer (1984) emphasize that a distinct and focused study path is established with the framing of specific research questions. The formulated research question revolves around leveraging supply chain risk management (SCRM) to enhance the resilience of healthcare supply chains, particularly in dealing with unexpected disruptions.

Independent Variable: Supply Chain Risk Management (SCRM). This variable represents the actions and strategies implemented by healthcare organizations to manage risks within their supply chains. It includes measures such as risk identification, assessment, mitigation, and response planning.

Dependent Variable: Resilience of Healthcare Supply Chains. This variable indicates the ability of healthcare supply chains to withstand and recover from disruptions while maintaining operations and fulfilling their responsibilities. It encompasses aspects like adaptability, flexibility, continuity, and efficiency in the face of unexpected events. The research aims to identify gaps in the existing literature concerning the effectiveness of SCRM in enhancing the resilience of healthcare supply chains. These gaps may include areas where current strategies are insufficient, factors that are not adequately addressed, or aspects that require further investigation to improve the resilience of healthcare supply chains.

4. Data collection
4.1 Selection of Database
 This Systematic Literature Review (SLR) will utilize the extensive Scopus database, which is renowned as the largest repository of peer-reviewed literature, to explore the research terms. Leveraging Scopus as a search engine will enable the identification of papers from reputable sources such as Science Direct, Taylor and Francis, Emerald, Springer, and other crucial databases that will be employed in this review.

4.2 Definition of search terms
The choice of specific search terms aligns with the need to comprehensively explore literature related to supply chain ecosystems, resilience, and risk management (aligned with the objective of the study). Two search fields were simultaneously employed with the below search terms on Scopus. The first search field consists of search terms—'**Health**,' '**Risk**,' '**Supply**,' and '**Chain** and by using **OR**, the second search field consists of terms **'Health**,' **'Risk**,' **'Supply**,' and **Network'.**The selected search terms are relevant to the topic of balancing risk and resilience in the healthcare supply chain. The term **'Health'** is essential in understanding the unique dynamics of healthcare supply chains, including the critical role of timely and effective delivery of medical and pharmaceutical products. The term **'Risk'** is vital for identifying and mitigating challenges and vulnerabilities within the healthcare supply chain that can impact its ability to deliver products efficiently and in a timely manner. The identification and management of potential risks can help to improve the resilience of the healthcare supply chain. The terms '**Supply' and 'Chain/Network'** are fundamental components that collectively define the healthcare supply chain ecosystem. In addition, 'Supply' and 'Chain/Network' are fundamental components that are essential for defining the healthcare supply chain ecosystem. These search terms are highly relevant to the study's purpose and objectives, enabling the identification of a broad range of literature on healthcare supply chain resilience and risk management. The search terms aim to provide a comprehensive approach to balancing risk and resilience in the healthcare supply chain through thorough research and analysis of relevant studies. By incorporating these terms into the search strategy, the aim is to create a nuanced understanding of the complexities of healthcare supply chains. This will lay the foundation for an in-depth assessment of the relationship between resilience and risk management, making the chosen key terms relevant and crucial for achieving the objectives of the study. This systematic review aims to provide valuable insights into the effective management of risk and resilience in healthcare supply chains.

4.3 Article Selection Process
4.3.1 Inclusion and Exclusion Criteria
Inclusion Criteria: Articles directly related to health in multiple industries, with a specific emphasis on healthcare. Articles ranked as Q1(first quartile), indicative of their significance and impact. Only Articles published in the years 2013-2023 are considered in this paper, fulfilling the inclusion criteria to review the latest articles not older than 2013.
Exclusion Criteria: Articles not directly related to the healthcare sector and supply chain risk management. Articles published in journals outside the Q1 category.

4.3.2 Search Overview
The initial search yielded a total of approximately 2181 articles, spanning various industries beyond the healthcare sector. Therefore, further filtration was necessary, as shown in Figure 1.
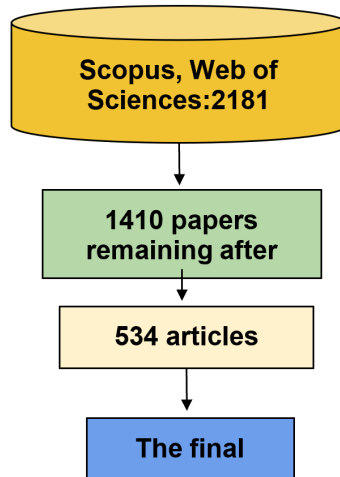
Figure 1. A funnel model view of data selection

4.3.3 First Filtration
Further refinement was necessary to focus specifically on the healthcare sector. Consequently, the selection was filtered to include only articles related to the healthcare industry, resulting in 1410 articles.

4.3.4 Quality Assurance
To ensure the inclusion of high-quality articles, we conducted an additional filtration step to select articles ranked as Q1 (first quartile at Scopus). This stringent criterion narrowed the selection down to 534 articles.

4.3.5 Final Selection
Meticulous selection from this subset was undertaken to extract the most pertinent articles that aligned with our research objectives and could help answer the research questions. This process resulted in a final selection of 121 articles. As shown in the Figure 1.

4.3.6 Rationale
This iterative and transparent filtration process guarantees that the articles included in this systematic literature review not only meet rigorous quality standards but also directly contribute to addressing the specific objectives of the research. The final selection is a focused and high-quality compilation that ensures relevance to our study's central themes.

5. Discussion
The selected themes of supply chain visibility and information sharing, the use of technology for SCRM resilience, innovative logistics and inventory management for SCRM resilience, and data quality and analytics have direct links to the formulated research question of leveraging supply chain risk management (SCRM) to enhance the resilience of healthcare supply chains in the context of unexpected disruptions like COVID-19.

SCRM is the independent variable in this research question, representing the actions and strategies implemented by healthcare organizations to manage risks within their supply chains. The themes of supply chain visibility and information sharing and the use of technology for SCRM resilience explore how healthcare organizations can improve their SCRM practices through better visibility and transparency, new technologies, and inter-organizational collaboration, which are all critical elements of SCRM.

Similarly, innovative logistics and inventory management for SCRM resilience explores how healthcare organizations can optimize their logistics and inventory management practices to enhance SCRM resiliency, which is a key component of SCRM. Finally, data quality and analytics, which are essential to identifying, assessing, and mitigating supply chain risks, are another critical element of SCRM.

The dependent variable in the research question is the resilience of healthcare supply chains. The themes of supply chain visibility and information sharing, the use of technology for SCRM resilience, innovative logistics and inventory management for SCRM resilience, and data quality and analytics all contribute to enhancing the resilience of healthcare supply chains by helping healthcare organizations better manage and respond to supply chain disruptions.

5.1 Numerical Results
The paper analyzes the distribution of articles across ten different countries, providing insights into the global representation within the selected literature. The results, both in numerical form, highlight the prevalence of research contributions from diverse geographical regions, as shown in Table 2.

Table 2. The article is counted by country or territory, derived from Scopus's analytical report

Countries	Article count
United States	42
United Kingdom	20
India	12
Iran	10
Australia	9
Italy	8
France	7
China	5
Netherlands	4
Brazil	4

5.2 Graphical Results
The graphical results section aims to visually represent key trends, patterns, and insights derived from the systematic analysis of the selected literature. Through various charts and graphs, we present a brief overview of the distribution and evolution emphasis within the body of literature under review. As depicted in Figure 2, the majority of selected documents are concentrated in the year 2022, indicating a deliberate focus on recent literature. This decision was made to capture the most current state of research and to align with the objective of exploring the latest developments in the field.
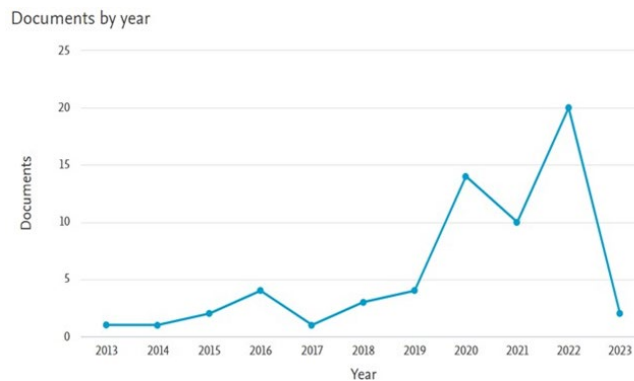

Figure 2. Articles by year, derived from Scopus analytical report

Supply chain risk management is a multidisciplinary field that involves considerations from various domains due to its complexity and the interconnected nature of supply chains. In the context of the topic, " A Systematic Literature Review of Exploring Healthcare Supply Chain Risk Management, Resiliency, and Future Research Implications," the

pie chart illustrates the distribution of literature across various disciplines. Each slice of the pie represents a different discipline, and the percentage attached to each slice indicates the proportion of literature related to the topic within the discipline, as shown in Figure 3.
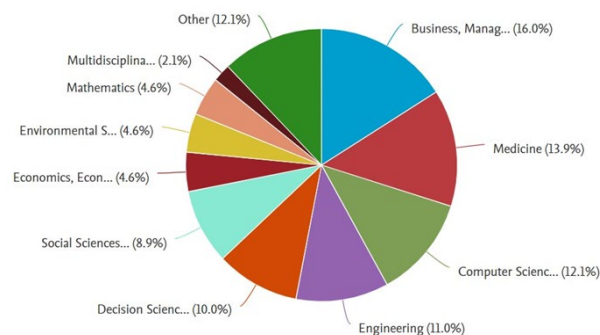

Figure 3. Articles by subject area, derived from Scopus analytical report.

5.3 Validation

The validation of the paper included rigorous methodology, a systematic approach, and careful supervision to ensure the quality and reliability of the research findings. The paper was authored by a student under the guidance of a knowledgeable professor, providing additional supervision and feedback during critical stages of the review process. The reliability of the inclusion and exclusion criteria was ensured through comprehensive search strategies across multiple databases. The selection and screening of articles were conducted independently and validated by the guiding professor to guarantee consistency and accuracy. The selected articles were critically analyzed and evaluated based on their relevance, quality, and contribution to the research topic. In conclusion, the validation process of the paper was conducted with a high level of rigour and accuracy, drawing on reputable journals' peer-review processes and extensive quality checks to ensure the research's validity.

6. Conclusion

After an in-depth analysis of the existing literature on SCRM and its resiliency, and through a constructed thematic analysis, this research concludes that while considerable research work has been performed on technology, innovation, and data sharing and visibility, mostly led in urban areas; limited articles investigate the H.C. of rural areas. Despite the involvement of technology in healthcare supply chains, there is still a lack of detailed research on the role of A.I. algorithm-based systems in H.C. Moreover, while there is significant research on the benefits of supply chain management and Lean Six Sigma separately, there is limited research exploring how integrating these two management practices can improve the resilience of supply chains in the healthcare industry. Consequently, the potential of supply chain-lean Six Sigma practices to enhance supply chain resilience in healthcare is yet to be well-documented in research articles.

Future research should focus on filling these gaps in knowledge. There is a need to explore how AI-based systems can contribute to improving SCRM resiliency, especially in rural areas that could benefit from cost-effective and innovative technology solutions. There is also a need to explore the potential of integrating supply chain management and lean Six Sigma principles as a way to improve the resilience of healthcare supply chains, optimize their operations in the face of unexpected disruptions, and improve overall healthcare outcomes. Addressing these gaps in research could lead to the development of innovative and effective strategies for healthcare organizations to mitigate risks, improve SCRM resiliency, and prepare for unexpected disruptions like COVID-19, enhancing the resilience of healthcare supply chains in the long run.

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Biography

Sana Latif is a dynamic scholar currently pursuing an MBA at the American University of Sharjah. With a background in Business Administration, she has focused on supply chain management during her academic journey. Courses in Management Decision Analysis and Applied Research during her master's program have honed her analytical skills. As a Graduate Research Assistant at AUS, The author actively contributes to research projects, combining theoretical knowledge with practical applications. Her commitment to societal impact is evident in her participation and finalist recognition in the "Women Empowerment Forum" research project in Sharjah in 2022. Sana Latif's interdisciplinary approach and dedication to research position her as a promising contributor to the fields of business administration and applied research.