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A Systematics Review on the Impact of Emergency Supply Chain Management, Operational Efficiency, and Supply Chain Traceability on Public Health

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Abstract

This systematic review aims to explore and analyze the intricate of Emergency Supply Chain Management (ESCM), Operational Efficiency (OE), and Supply Chain Traceability (SCT) in ensuring public health during crises. The study systematically reviews and synthesizes relevant literature from Scopus, Web of Science, Emerald, and Elsevier, employing the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework. A comprehensive search across databases yielded 3,755 articles, from which 57 articles were selected for detailed analysis based on inclusion and exclusion criteria. The selected articles were critically assessed for their contribution to understanding the impact of ESCM, OE, and SCT impact on public health outcomes. The systematic review reveals key insights into the multifaceted influence of ESCM, OE and SCT on public health. Findings encompass the adoption of advanced technologies, such as RFID and blockchain, to enhance traceability in medical supply chains. OE, providing information on how coordinated procedures and wise resource distribution support the prompt and efficient provision of medical resources in both emergency scenarios and regular business operations. Managerial initiatives and standardized policies emerge as pivotal factors in ensuring efficient public health logistics. Collaboration between Non-Governmental Organizations (NGOs) and government agencies plays a crucial role in mitigating challenges and optimizing public health.

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1. INTRODUCTION

Traceability in the supply chain and Emergency Supply Chain Management are critical components in guaranteeing the effective and efficient distribution of assistance during times of crisis (Shafiq & Soratana, 2019a). According to Yáñez-Sandivari et al. (2021), the management and coordination of resources, information, and processes in order to satisfy the requirements of populations impacted by emergencies or disasters constitutes Emergency Supply Chain Management. This discipline pertains to the transportation, warehousing, and dissemination of commodities and services, with an emphasis on providing prompt and focused assistance to mitigate human distress. When considering emergency operations, the traceability of the supply chain emerges as an essential element.

Traceability of the movement and status of products, materials, or information along the entire supply chain is referred to as operational efficiency, and supply chain traceability (Moretto & Macchion, 2022). Yousefi and Tosarkani (2022) noted that traceability facilitates accountability and transparency by allowing organizations to observe the movement of resources from their point of origin to their final destination. Traceability of supplies is crucial in emergency contexts for a multitude of reasons, encompassing inventory management, quality control, and the monitoring of aid distribution.

According to Roy (2021) Operational Efficiency and Traceability incorporation in Emergency Supply Chain Management serves to augment accountability and visibility throughout the entirety of the supply chain. The visibility in question assumes particular significance when it comes to confronting issues such as aid diversion, fraud, and larceny. In addition, traceability enables the surveillance of the state and expiration date of medical supplies, thereby guaranteeing the provision of public health interventions that adhere to the utmost standards of quality. Scholars have begun to acknowledge the growing importance of Emergency Supply Chain Management and operational efficiency, and supply chain traceability in enhancing the efficacy and influence of emergency assistance, as documented in the academic literature (Masudin, Lau, et al., 2021; Shafiq & Soratana, 2019a). As identified by Knoops (2019) , numerous facets have been the subject of research, encompassing the application of technology to ensure traceability, the significance of collaborations in coordinating logistics, and the impact of traceability on the standard of public health provision in emergency settings as a whole.

An investigation was carried out by Altay and Kovács (2018) to analyze the application of traceability technologies within emergency supply chains. The study emphasized the favorable effects that such technologies have on enhancing supply chain visibility and accountability. Brown (2019) conducted a study to examine the correlation between logistics coordination and the punctual provision of public health resources during times of crisis. The author underscored the importance of implementing traceability systems as a means to improve coordination endeavors.

The significance of public health in emergency contexts is of the utmost importance, as it has a direct impact on the survival and well-being of populations that are most susceptible to crises, disasters, or conflicts. Ensuring the provision of superior public health in such circumstances is an intricate and diverse undertaking that necessitates thoughtful evaluation of numerous elements to guarantee efficacious and significant aid (Kohrt et al., 2019).

According to Väyrynen (2023), acute health emergencies frequently give rise to a heightened need for public health services as a consequence of the injuries, illnesses, and other complications that ensue during emergency crises. Consequently, Tzenios (2019) noted that the assurance of high-public health assumes utmost significance in the prevention of additional illnesses and deaths. This emphasizes the criticality of public health interventions that comply with established medical protocols, standards, and ethical principles in order to guarantee optimal results for those impacted. Furthermore, the overall efficacy of the response is intricately linked to the quality of public health in emergency settings. Prompt and suitable medical interventions not only benefit the well-being of the affected individuals but also promote the overarching objective of alleviating the crisis's repercussions on the community(Moser-Mercer et al., 2021). Preventing the progression of health-related issues, alleviating the strain on the impacted populace, and fostering community resilience are all objectives of public health that is executed with efficacy as noted by (Lal et al., 2022).

Scholars have emphasized the significance of public health in emergency settings and its ramifications for the welfare of impacted populations in scholarly works. The importance of implementing standardized public health practices in emergency contexts was underscored by Tayyib (2022), who contended that strict adherence to quality standards is indispensable for attaining favorable health results. Furthermore, Brown (2019) conducted a study that examined the opportunities and challenges associated with ensuring the quality

of public health during emergency responses. Their research shed light on the intricate nature of providing efficient medical care amidst times of crisis.

In emergency settings, ensuring the quality of public health also necessitates consideration of accessibility, cultural sensitivity, and community engagement. These components are crucial for the efficacy and acceptance of public health interventions among the population being treated, thereby influencing the overall success of the initiatives (Lal et al., 2022).

Despite the increasing acknowledgement of the pivotal significance attributed to Emergency Supply Chain Management and operational efficiency, and supply chain traceability in the provision of public health amidst crises, a discernible void can be found in the extant body of research. Recent research has predominantly concentrated on particular facets, such as the isolated coordination of logistics or the implementation of traceability technologies. However, there is a lack of comprehensive comprehension regarding the manner in which traceability in the supply chain affects the quality of public health in emergency settings as a whole. The objective of this review is to ascertain these deficiencies and integrate the current body of knowledge in order to present a thorough synopsis of the topic.

Prior investigation into the implementation of traceability in emergency supply chains was conducted by Khan, Lee, et al. (2019), with an emphasis on its operational facets. Understanding the wider difficulties of traceability on public health, particularly in resource-limited and crisis-prone settings, is thus significantly lacking.

The primary motivation for undertaking this systematic review is to address the identified deficiencies in the existing body of literature and make a scholarly contribution towards a more comprehensive comprehension of the interplay between public health, operational efficiency, and supply chain traceability, Emergency Supply Chain Management. The review holds considerable importance as it has the capacity to enlighten policymakers, researchers, and emergency practitioners regarding the critical determinants that impact the efficacy of public health interventions during times of crisis.

Through the methodical synthesis of prior research, the objective of this review is to offer a thorough and empirically supported analysis of the influence that operational efficiency, and supply chain traceability has on public health outcomes. It is anticipated that the results will provide valuable insights for subsequent investigations, the development of policies, and the implementation of practical strategies, ultimately improving the efficacy of public health provision in emergency contexts. Expanding upon the research conducted by Tarrataca et al. (2021) regarding the impact of technology on enhancing Emergency Supply Chain Management, the present systematic review delves into the interplay between public health, traceability, and logistics. While the study by Tarrataca et al. (2021) provided valuable insights into technological advancements, it failed to explore the precise difficulties for public health. This underscores the necessity for a concentrated and methodical investigation of this critical interconnection.

2. METHODS

A systematic literature review (SLR) was used to answer our research questions, this article is based on the requirements for a high-quality literature review. referring to Hart (2018), the quality of a review depends on appropriate breadth and depth, accuracy and consistency, clarity and brevity, as well as practical analysis and synthesis. Over time, systematic literature reviews have been used to assess available information on a particular topic by combining the findings of qualitative and quantitative studies. A new methodology has been developed with the help of quality assurance standards to make reviews according to various objectives and requirements (Moher et al., 2009). Evaluation of the recent literature has resulted in new conceptualizations or frameworks within a fragmented and emerging field of research (Torraco, 2005).

A systematic literature review is a method for understanding large amounts of information (Petticrew & Roberts, 2008). Literature review is becoming increasingly important because of the increased development and specialization of academic knowledge production. The academic literature emphasizes that systematic reviews must be carried out according to a certain process that includes several steps(Hart, 2018; Kashani et al., 2021). Following this requirement, a systematic review of the literature is carried out in the sequence of five different steps:

a. Planning: preparation of research questions and research objectives.
   The first phase is done by planning research and formulating research questions. The research was carried out to analyze relevant literature in the context of Emergency Supply Chain Management and operational efficiency, and supply chain traceability on the quality of public health, so the research questions were formulated as follows: (1) What is the Current State of Knowledge Regarding the Integration of Traceability in Emergency Supply Chains? (2) How Does Operational efficiency, and supply chain traceability Impact the Accessibility and Timeliness of Public health in Emergency Contexts? The SLR is aimed at achieving two main research objectives. First, to assess the current state of knowledge regarding the impact of Emergency Supply Chain Management and operational efficiency, and supply chain traceability on the quality of public health in crisis situations. Second, to examine the relationship between operational efficiency, and supply chain traceability and the quality of public health in emergency contexts.

b. Data Collection: Comprehensive Search
   The second phase is planning how data is collected. We start collecting data from popular databases such as Scopus, Web of Science, Emerald and Elsevier. We selected these databases because it encompasses a comprehensive range of refereed journals belonging to major publishers. In addition, this database allows ranking based on quotations, so it is considered to have the best quality articles(Mishra et al., 2018).Based on research questions, we compile keyword strings that will be used to look for research literature around the topic of responsible consumption behavior or sustainable consumerism. A combination of different keywords such as AND, OR, and NOT is used in advanced search to obtain relevant and specific articles. The keyword strings used in this study are as follows: ("Emergency Supply Chain Management" OR "operational efficiency", "supply chain traceability " OR "public health" OR "medical supply chain" OR "crisis response") AND ("disaster relief" OR 'emergency aid' OR "traceability technology" OR "public health") AND ("emergency logistics"). In addition, we impose the following initial restrictions on the publication of articles: refer to table 1, Inclusion criteria and exclusion criteria.

Table 1. Inclusion criteria and exclusion criteria

Inclusion criteria:
Articles must be published in peer-reviewed journals.
Articles must be conducted in emergency contexts or crisis situations.
Studies examining the impact of operational efficiency, and supply chain traceability on public health.
Articles must be written in English
Research employing rigorous methodologies, including quantitative, qualitative, or mixed-methods approaches
Academic literature published within the timeframe of 2013 to 2023.

Exclusion criteria:
Articles not published in English to maintain consistency in language.
Grey literature, such as conference abstracts or unpublished reports, to ensure the inclusion of peer-reviewed, rigorously assessed research.
Articles not directly related to the intersection of Emergency Supply Chain Management, operational efficiency, and supply chain traceability, and public health.
Research with inadequate methodological rigor or insufficient reporting of methods and results

Source: Researcher Development (2023)

c. Choosing and evaluating studies

The study utilized the PRISMA methodology. PRISMA involves an iterative process of selecting and reviewing papers to develop a final collection of relevant articles for review. It increases the reliability of the review by utilizing predefined procedures for reducing bias and extracting research trends and issues (Kashani et al., 2021). PRISMA has become a well-established and highly used systematic review method in the literature (Liberati et al., 2009) Therefore, we have selectively reviewed relevant articles over the past ten years to understand Emergency Supply Chain Management and operational efficiency, and supply chain traceability in quality health care. We follow the process suggested by Petticrew and Roberts (2008). The entire process followed in this study is shown in Figure 1.

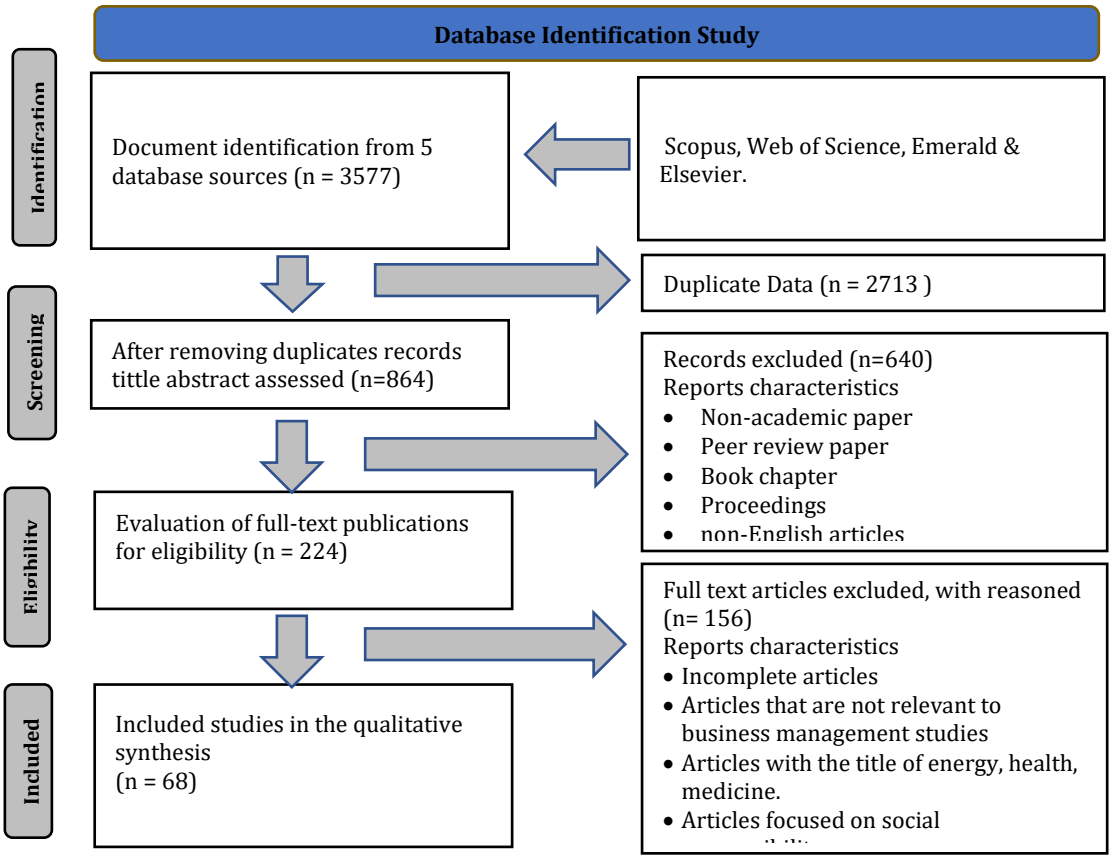

Figure 1. PRISMA Flow: data extraction procedure
Source: Data Processed (2023)

d. Analyze the study descriptively and thematically

This section is designed to present the results and findings of the analysis, which is a narrative of previously defined codes. This section is done using the template analysis referenced by King (2012). The primary purpose of the analysis template is to identify, organize, and analyze relevant information in a consistent way (Page et al., 2021).

Qualitative-shaped data from the collection of selected journals is analyzed to answer research questions. Template analysis includes a set of questions, instructions, or steps to follow to analyze data in a systematic and structured way. The template analysis performed in this SLR phase is described in table 2.

Table 2. Descriptive and thematic categories

	Category	Information About Category
Descriptive	Years	Year of the Official Journal Article Publication
	Title and Variables Research	Topics and actual variables related to ESCM, OE, SCT & PH
	Journal Publications	Scope of journals that publish ESCM, OE, SCT, & PH articles
Thematic	Context of Emergency Supply Chain Management and operational efficiency, and supply chain traceability on the quality of public health in previous research	The current knowledge regarding the integration of traceability in emergency supply chain.
	Important dimensions in previous research	Updating dimensions and driving factors related to ESCM, OE, SCT & PH
	Visible gaps and knowledge to be extracted in the next research	Discovery of gaps in previous research and information needed for future research in context

Source: Data Processed (2023)

e. Report and use results

The results of the review process are presented in the results and discussion section. These results facilitate the development of research agendas, including suggestions for new study directions. Some implications for the current knowledge regarding the integration of traceability in emergency supply chain. And dimensions and driving factors related to ESCM, OE, SCT & PH. Discovery of gaps in previous research and information needed for future research.

3. RESULT AND DISCUSSION

The first objective of this systematic literature review is to assess the current state of knowledge regarding the impact of Emergency Supply Chain Management and operational efficiency, and supply chain traceability on public health in crisis situations. The categories used for this descriptive analysis are obtained from a collection of articles based on the year of publication, the title, the journal and the type of publisher. The distribution of articles according to the year of publication is shown in figure 2. The articles we selected is structured as an article published in 2013-2023.

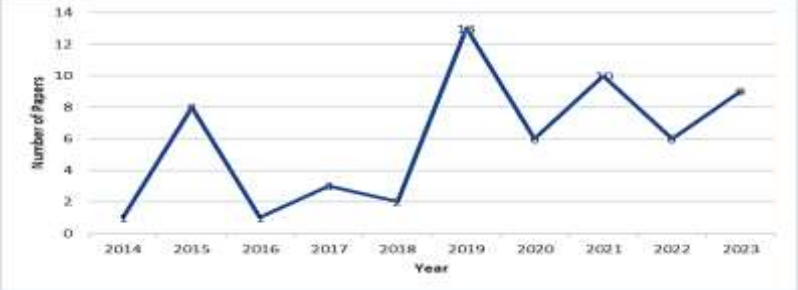

Figure 2. distribution of articles by year of publication
Source: Data Processed (2023)

From figure 2, the number of articles published from 2013 to 2023 on Emergency Supply Chain Management and operational efficiency, and supply chain traceability in public health. The graph shows that the number of articles published on this topic has increased significantly over the past few years. This is likely due to the growing importance of Emergency Supply Chain Management and operational efficiency, and supply chain traceability in ensuring the delivery of public health to people in need (Masudin, Lau, et al., 2021).Emergency Supply Chain Management is the process of planning, organizing, and managing the flow of goods and services to people affected by disasters or emergencies. Operational efficiency, and supply chain traceability is the ability to track the movement of goods and services through a supply chain (Shafiq & Soratana, 2019a).

There are a number of reasons why Emergency Supply Chain Management and operational efficiency, and supply chain traceability are important for public health. First, Emergency Supply Chain Management can help to ensure that essential medical supplies and equipment are delivered to people in need in a timely and efficient manner. This is especially important in disaster situations, when access to public health may be limited (Babatunde et al., 2020; Dolinskaya et al., 2018). Second, operational efficiency, and supply chain traceability can help to ensure the safety and quality of medical products. By tracking the movement of medical products through a supply chain, it is possible to identify and remove any products that may be contaminated or counterfeit (Musamih et al., 2021).

Third, operational efficiency, and supply chain traceability can help to improve the efficiency and effectiveness of public health organizations. By understanding how medical products move through their supply chains, public health organizations can identify and address any bottlenecks or inefficiencies (Hajipour et al., 2021).

The increasing number of articles published on Emergency Supply Chain Management and operational efficiency, and supply chain traceability in public health suggests that there is a growing interest in this topic. This is a positive development, as it indicates that more and more people are recognizing the importance of these two areas for ensuring the delivery of public health to people in need.

Citation Analysis

Table 3. Citation counts as of November 2023

Authors	Citation Count	Journal	Publishers
Kovács and Falagara Sigala (2021)	151	Journal of Supply Chain Management	Wiley Online Library
Vega and Roussat (2015)	107	International Journal of Physical Distribution & Logistics Management	emerald.com
Jensen and Hertz (2016)	66	International Journal of Logistics Research and Applications	Taylor &Francis
Modgil et al. (2020)	62	Annals of operations research	Springer
Benzidia et al. (2019)	55	International Journal of Logistics Research and Applications	Taylor &Francis
Budak et al. (2020)	52	Applied Soft Computing	Elsevier
Khan et al. (2021)	45	IEEE Access	ieeexplore.ieee.org
Vega (2018)	44	journal of Emergency Supply Chain Management and Supply Chain Management	emerald.com
Masudin, Ramadhani, et al. (2021)	44	Global Journal of Flexible Systems Management	Springer

Illahi and Mir (2021)	42	Environment, Development and Sustainability	Springer
Power (2019)	35	Thinking infrastructures	emerald.com
Masudin, Lau, et al. (2021)	33	Cogent business and management	Taylor &Francis
Negi and Negi (2021)	30	International Journal of Emergency Services	emerald.com
Ada et al. (2021)	30	Sustainability	mdpi.com
Chong et al. (2019)	27	journal of Emergency Supply Chain Management and Supply Chain Management	emerald.com
Shafiq and Soratana (2019a)	26	Log Forum	yadda.icm.edu.pl
Khan, Yong, et al. (2019b)	23	Int. J Sup. Chain. Mgt	researchgate.net
VanVactor (2017)	22	Journal of Business Continuity & Emergency Planning,	ingentaconnect.com
Altay et al. (2021)	19	Journal of Emergency Supply Chain Management and Supply Chain Management	emerald.com
Shafiq and Soratana (2019b)	18	Log Forum	bibliotekanauki.pl

Source: Data Processed (2023)

Scopus was utilized to gather data on article citations for the study, and this information was then used to evaluate the significance of prior research. Table 3 displays the 20 articles with the most citations. 35.1% of all references to the 57 publications came from just 10 sites. Majority of the articles came from Emerald, followed by Taylor and Francis and Springer and the rest.

Distributing articles based on publishers, we found that 74% of articles related to Emergency Supply Chain Management and operational efficiency, and supply chain traceability in quality health in crisis were distributed to at least seven (7) publishers. Figure 3 depicts the distribution, Emerald, Springer, MDPI, Elsevier, Taylor & Francis, Inderscience, Ieeexplore are known as large publishers and have many variants of journals. The well-known publisher is focused on publishing quality articles and has a network of journals worldwide. The publishers all have an excellent reputation; this is demonstrated by the reach and impact of the publisher network, which can reach a broad audience, including researchers, academics, practitioners, and policymakers. Thes 57 articles selected showed that Emergency Supply Chain Management and operational efficiency, and supply chain traceability had become important as proved by the publications of the seven of the world's top publishers.

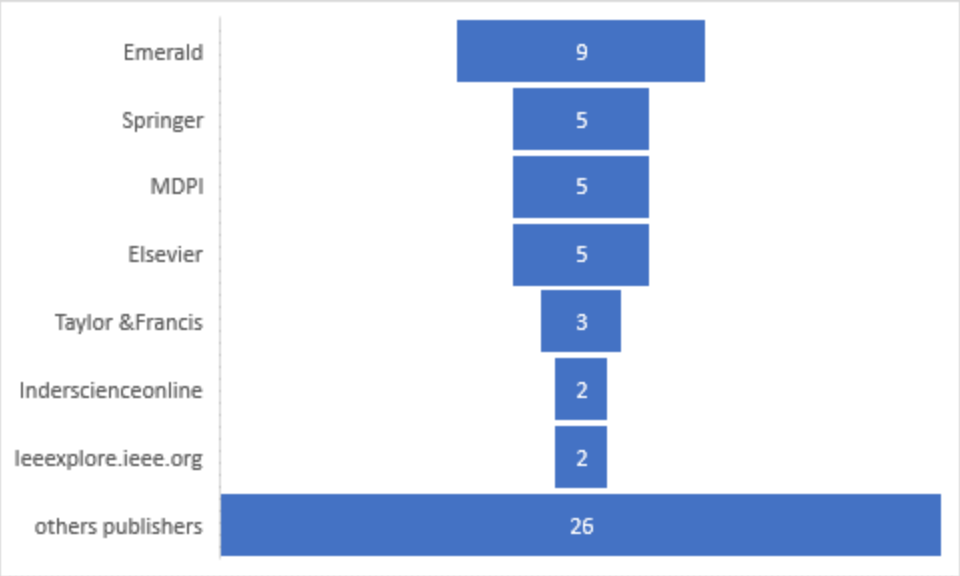

Figure 3. Articles Distribution by Publisher
Source: Data Processed (2023)

Figure 3, shows the distribution of articles by publishers. The figure suggests that Emerald is the most prolific publisher in this field, followed by Springer, MDPI, Elsevier, and Taylor & Francis. These seven publishers account for over half of the articles published in this field. It is also worth noting that the of articles (45.6%) are published by other publishers. This suggests that there is a diversity of publishers in this field (Emergency Supply Chain Management and operational efficiency, and supply chain traceability), and that Emerald, Springer, MDPI, Elsevier, and Taylor & Francis are not the only publishers who are publishing high-quality research in the is field.

Current state of knowledge regarding the integration of operations and traceability in Emergency supply chain.

Out of the 57 articles reviewed, some of the authors explicitly defined the term Emergency Supply Chain Management and operational efficiency, and supply chain traceability . Kovács and Falagara Sigala (2021) and Masudin, Lau, et al. (2021) explicitly defines the term Emergency Supply Chain Management as the planning, coordination, and control of the efficient and effective flow of resources, including personnel, information, and material, to meet the emergency needs of populations affected by natural disasters, conflicts, or other emergencies. Again Modgil et al. (2020) defines Emergency Supply Chain Management as the planning, coordination, and management of the flow of goods, services, and information in emergency operations. It involves activities such as procurement, transportation, warehousing, and distribution of relief items to affected populations. Whiles Operational efficiency, and supply chain traceability in the context of Emergency Supply Chain Management refers to the ability to track and trace the movement of relief items throughout the supply chain, from procurement to distribution. It involves capturing and recording information about the origin, location, and handling of the items to ensure transparency and accountability(Masudin, Lau, et al., 2021). Table 4 showing the definitions of ESCM, OE, and SCT of the top cited articles.

Table 4. Defining Emergency Supply Chain Management and operational efficiency, and supply chain traceability

Author and Year	Definitions	
	Emergency Supply Chain Management	**Operational efficiency, and supply chain traceability**
Kovács and Falagara Sigala (2021)	Logistics involves the systematic management of the efficient movement and storage of commodities, materials, and information from their starting point to the end point of consumption.	No precise definition
Masudin, Ramadhani, et al. (2021)	Emergency Supply Chain Management is the strategic organization and coordination of resources, information, and actions to provide timely assistance to individuals and communities affected by calamities or emergencies.	Emergency Supply Chain Management ensures operational efficiency and traceability by monitoring commodity, information, and resource flow, ensuring transparency, responsibility, and observability through data acquisition and documentation.
Shafiq and Soratana (2019a)		Emergency Supply Chain Management ensures operational efficiency and traceability by monitoring goods, materials, and information flow, ensuring transparency, responsibility, and effectiveness in delivering goods and services to affected communities.
Jensen and Hertz (2016)	Emergency Supply Chain Management is the strategic organization and supervision of resources and operations during emergencies, encompassing transportation, warehousing, and distribution of products and services to affected communities.	Emergency Supply Chain Management enhances operational efficiency and traceability by monitoring and tracing product and service flow from procurement to distribution, promoting transparency and responsibility.
Shafiq and Soratana (2019b)	Emergency Supply Chain Management ensures operational efficiency and traceability by monitoring goods, materials, and information movement, ensuring transparency, accountability, and effectiveness in delivering goods and services to affected communities.	
Khan et al. (2021)	Emergency Supply Chain Management is the strategic organization and coordination of resources and operations to provide aid, aid supplies, and promote human rights and peace during emergencies.	Emergency Supply Chain Management focuses on operational efficiency and supply chain traceability, ensuring transparency and accountability by monitoring product and resource flow across procurement and distribution.
Altay et al. (2021)	Emergency Supply Chain Management is a specialized field	

	that manages logistics in emergencies, ensuring the efficient acquisition, transportation, and distribution of commodities and services to impacted communities.	
Chong et al. (2019)	Emergency Supply Chain Management is the efficient and responsible management of products and supplies to alleviate the suffering of vulnerable individuals during disasters.	
Vega (2018)	Emergency Supply Chain Management is the strategic coordination of resources, procedures, and endeavors to provide support to individuals impacted by calamities or emergencies.	
Vega and Roussat (2015)	Emergency Supply Chain Management involves efficient organization and coordination of logistical operations for disaster relief efforts, including planning, procurement, transportation, and distribution of goods and services.	
Khan, Yong, et al. (2019a)	Emergency Supply Chain Management (ESCM) is a systematic approach to efficiently manage the movement, storage, and distribution of products, materials, and information to provide aid and alleviate human suffering.	
Budak et al. (2020)	Emergency Supply Chain Management is crucial for coordinating and managing operations to deliver essential relief supplies to disaster-affected regions, ensuring safety and preventing distress.	
Ma et al. (2023)	Emergency Supply Chain Management is the strategic management of commodities, services, and information to meet the needs of those affected by natural disasters, wars, or other urgent situations.	Emergency Supply Chain Management ensures operational efficiency and traceability by monitoring and tracking item movement, ensuring transparency, responsibility, and integrity of emergency relief, facilitating efficient coordination during emergencies.
Sreedharan et al. (2020)	Emergency Supply Chain Management is the strategic coordination and control of product, service, and information movement in emergency operations, focusing on relief measures in response to natural disasters.	The article highlights challenges in establishing a well-organized supply chain in emergency relief operations, such as resource scarcity and high delivery risk.

Gonzalez-Feliu et al. (2020)	The article defines Emergency Supply Chain Management as a Emergency Supply Chain Management aims to mitigate disaster impacts through resilient logistics systems, focusing on risk reduction, pre-disaster readiness, disaster response, and post-disaster rehabilitation, despite progress in reducing fatalities.	
Bosona and Gebresenbet (2023)	The sources lack a clear definition of Emergency Supply Chain Management and operational efficiency, and supply chain traceability, focusing on blockchain technology's use in agri-food supply chains. They emphasize the importance of traceability, transparency, and auditability in managing food quality, enhancing consumer happiness, and minimizing food loss. Blockchain technology can establish a distributed, open, trustworthy, and automated system for instantaneous monitoring and decision-making in AFSCs.	
Khan et al. (2022)	Emergency Supply Chain Management is the systematic management and coordination of resources and services for disaster relief, aiming to preserve lives, mitigate distress, and contribute to sustainable development. The article emphasizes the importance of digital solutions and technology in disaster relief operations for improving efficiency, equity, and security.	

Source: Data Processed (2023)

Table 4 displays definitions of Emergency Supply Chain Management and operational efficiency, and supply chain traceability as supplied by many authors across different years. Although there may be some differences in terminology and emphasis, the definitions ultimately agree on the following crucial points:

Emergency Supply Chain Management

This discipline focuses on efficient management and coordination of resources and operations to provide relief and support to individuals affected by disasters or emergencies, aiming to preserve lives, relieve distress, and contribute to sustainable development.

Operational efficiency, and supply chain traceability

The system monitors and tracks commodity, information, and resource flow in the emergency supply chain, ensuring data acquisition, documentation, and transparency to protect emergency relief integrity and quality.

Implications from the definition

From the analysis the following implications were arrived at Standardization of definitions in Emergency Supply Chain Management improves collaboration and communication among stakeholders. Digitization and blockchain technology can enhance tracking and optimization of assistance processes. A holistic approach is needed, encompassing risk reduction, disaster readiness, and recovery. Accountability and transparency are prioritized, while adaptability and resilience are essential for enduring disruptions. A comprehensive strategy is crucial for successful response and sustainable growth.

Further Research from ESCM, OE, and SCT

Research is needed to measure the impact of operational efficiency and supply chain traceability on Emergency Supply Chain Management effectiveness. Sharing best practices and addressing ethical considerations is crucial. Investing in technology and innovation is also essential. By understanding these implications, stakeholders can work together to improve aid delivery efficiently.

Variables used by the various authors and their findings

Table 5. Variables and findings

Author and Year	Variables	Findings
Shafiq and Soratana (2019a)	Identification and labelling of goods, tracking technologies, recording sharing of information, communication networks.	emphasized the importance of testing theoretical, the study recommended the exploration of standardized policies and procedures to enhance effectiveness and efficiency in logistics and supply chain operations of emergency organizations.
Masudin, Ramadhani, et al. (2021)	the adoption of traceability systems, electronic data exchange (EDI), radiofrequency identification (RFID), blockchain, managerial initiatives.	The study found that the implementation of traceability systems like EDI, RFID, and blockchain significantly impacted the food cold chain performance during the Covid-19 pandemic.
Illahi and Mir (2021)	The operational efficiency characteristics that play a vital role during pandemics	The paper highlights twelve areas for enhancing ESCM operations during and after pandemics, but lacks specific findings on Emergency Supply Chain Management and operational efficiency.
Modgil et al. (2020)	Enablers factors Transparency, information sharing, while Challenge, financial services & identity protection	The study emphasizes the significance of transparency and information sharing in emergency operations success, emphasizing the need for further research to address quality management gaps.
Jensen and Hertz (2016)	The article examines the coordination and roles of the emergency cluster system in two case studies, focusing on its initial development and the Kenyan Post-election crisis.	The authors suggest a classification of roles in the emergency supply chain, emphasizing the need for clarity to prevent issues during and after cluster activation and deactivation.
Khan et al. (2021)	The study explores the relationship between IoT and blockchain technology, focusing on the mediating variables of transparency, public trust, andcoordination.	The study reveals that integrating IoT with BCT enhances transparency, public trust, coordination, and Emergency Supply Chain Management performance, making it a valuable contribution to the literature. coordination in Emergency Supply Chain Management

	between IoT/BCT and public trust/coordination	
Altay et al. (2021)	The article highlights the concerns of Emergency Supply Chain Management practitioners, including the impact of the COVID-19 pandemic and other long-term issues, without specifying specific variables studied.	The article highlights the need for more collaborative research in Emergency Supply Chain Management to enhance its relevance and impact. It suggests improving cross-fertilization with other disciplines like disaster risk reduction, disaster management, public health, and international emergency law. It also calls for Emergency Supply Chain Management to be more widely understood and known in society.
Chong et al. (2019)	The model considers a wide range of variables, including warehouse locations, distribution points (PODs), inventory levels, costs, and the uncertainty of various factors such as the affected population and their resilience	The proposed model can be used to determine emergency aid supply and its distribution with uncertainty, taking into account the affected population and their resilience. It provides a new perspective on disaster management, bridging the gap between applied research and human behavior in crisis situations
Vega (2018)	The study focused on examining the use of case studies in Emergency Supply Chain Management research. It analyzed the purpose, type and volume of data, type of analysis, and chain of evidence in the selected case studies.	The study highlighted gaps in Emergency Supply Chain Management research, particularly in the use of case studies and the use of frameworks for analysis, and proposed a framework to help researchers design and conduct effective case studies.
Vega and Roussat (2015)	The paper explores the role of logistics service providers (LSPs) in emergency relief supply chains, their inclusion in academic literature, and their online communication about their role.	The research reveals that logistics service providers (LSPs) are increasingly highlighting their roles in relief networks, indicating a growing interest in their involvement in Emergency Supply Chain Management and potential business opportunities. emergency supply chains
Masudin, Lau, et al. (2021)	The research examines the adoption of electronic data interchange, blockchain, radiofrequency, identification, traceability of Emergency Supply Chain Management, and its performance.	The results of the research indicate that EDI adoption does not have a significant effect on the traceability of Emergency Supply Chain Management. Further details about the findings are not provided in the available sources
Khan et al. (2021)	The study explores the relationship between IoT and blockchain technology, focusing on transparency, public trust, and coordination, with transparency acting as a mediating variable.	The study reveals that integrating IoT with BCT enhances transparency, public trust, coordination, and performance in Emergency Supply Chain Management, thereby contributing to the literature on these topics.
Chong et al. (2019)	The model considers various factors such as warehouse locations, distribution points, inventory levels, costs, and the resilience of the affected population.	The model enables the determination of emergency aid supply and distribution, addressing uncertainty and resilience, offering a new perspective on disaster management.

Budak et al. (2020)	The study evaluates real-time location systems (RTLS) for emergency relief logistics warehouses using fuzzy-based decision-making, revealing Wi-Fi RTLS as the best choice through sensitivity analysis.	The study identifies the "Wi-Fi RTLS" system as the optimal RTLS technology for Emergency Supply Chain Management warehouses, using a holistic approach considering benefits and risks, and validating the methodology through sensitivity analysis.
Ma et al. (2023)	Independent variable: Digital Transformation Mediator variables: Information Sharing Traceability Dependent variable: Sustainable Supply Chain Performance	Digital transformation positively impacts sustainable supply chain performance, with traceability mediating the relationship. Information sharing and traceability have synergistic effects on sustainable supply performance.
Sreedharan et al. (2020)	The article does not explicitly mention any specific variables used in the study	The study explores Emergency Supply Chain Management trends, proposes a MAPA model for managing challenges and addressing relief needs in emergency operations, offering a new approach for researchers.
Gonzalez-Feliu et al. (2020)	The maturity of Emergency Supply Chain Management systems in recurrent crises is determined by the administration of donations, design of distribution networks, and supplier selection.	The effectiveness of Emergency Supply Chain Management systems in recurrent crises is influenced by donation administration, distribution network design, and supplier selection.
Bosona and Gebresenbet (2023)	The main focus of the study was on the application of BCT in traceability systems in AFSCs, specifically in the traceability of agricultural goods	BCT-traceability systems improve AFSC management for fruits, vegetables, meat, dairy, and milk, but face challenges like disruption, data ownership complexity, and counterfeiting vulnerability.
Khan et al. (2022)	The study evaluated the impact of digitalization on Emergency Supply Chain Management (ESCM) in disaster relief operations, focusing on its independent role as a significant predictor.	The study emphasizes the significance of timely, fair, and safe emergency aid for lifesaving, highlighting the need for proper technology implementation in Disaster Risk Reduction Organizations.
Schumann-Bölsche and Schön (2015)	The study explores the potential and challenges of Emergency Supply Chain Management in Sub-Saharan Africa, utilizing Raspberry Pi single-board computers and sensor networking.	The paper evaluates the suitability of Raspberry Pi and other single-board computers integrated into sensor networks for Emergency Supply Chain Management in Sub-Saharan Africa
Ab Malik et al. (2020)	Trust Coordination Collaboration between government agencies and NGOs Communication	Trust and coordination are crucial for efficient disaster relief logistics, with NGOs reducing government agency burden through contract agreements, minimizing risks, and ensuring efficient coordination.

Source: Data Processed (2023)

From the table 5, out of the analysis, some authors did not explicitly state the variables used. The study highlights the importance of Emergency Supply Chain Management and operational efficiency in improving the effectiveness and responsiveness of emergency operations. It identifies four key factors: enhanced transparency and accountability, technological integration and innovation, coordination and collaboration, risk mitigation and resilience, need for standardization and policy frameworks, role of managerial initiatives, incorporation of Emergency Supply Chain Management into society, sustainability and achieving development goals, community engagement and maturity in logistics systems, and challenges in technological adoption.

Enhanced transparency and accountability are achieved through the adoption of traceability systems, tracking technologies, and information sharing. Technological integration and innovation, such as RFID, blockchain, and IoT, positively impact traceability and overall logistics performance. Effective coordination and collaboration are crucial for successful emergency operations. Risk mitigation and resilience are identified as key areas for improvement during and after pandemics. Standardization and policy frameworks are recommended to enhance effectiveness and efficiency in logistics and supply chain operations. Managerial initiatives positively impact the performance of the food cold chain during the pandemic. Incorporating Emergency Supply Chain Management into society can lead to more support, engagement, and collaboration. Digitalization and technology adoption contribute to fast, fair, and safe emergency supply chain management. Community engagement and maturity in logistics systems enhance the effectiveness and responsiveness of emergency efforts.

Further studies from the implications of the findings

The study provides valuable insights into Emergency Supply Chain Management and operational efficiency, as well as supply chain traceability. It suggests further research areas such as the impact of technology adoption, managerial initiatives, standardization, community engagement, challenges in technology adoption, logistics service providers, sustainability, cross-disciplinary research, quality management, public trust and communication, fast, fair, and safe emergency supply chain management models, risk management and resilience in pandemics, and the role of NGOs in emergency supply chain management. These areas aim to build upon existing knowledge, address gaps, and contribute valuable insights to the field. Researchers can choose specific aspects based on their expertise, interests, and relevance to current challenges and advancements in the field. The study also explores the role of logistics service providers in emergency relief supply chains, the sustainability implications of digitalization and technology adoption, cross-disciplinary research, quality management in emergency operations, public trust and communication, fast, fair, and safe emergency supply chain management models, risk management and resilience in pandemics, and the role of NGOs in emergency supply chain management.

Knowledge Gaps in Emergency Supply Chain Management, Operational efficiency, and supply chain traceability Research

There is a lack of empirical research on Emergency Supply Chain Management and its effectiveness, with a focus on quantitative approaches and data from actual emergency activities. The integration of disparate technologies, human components, and social context are also under-researched. The long-term effects and durability of these systems are often overlooked. Collaboration and data sharing are crucial for efficient operations, and research should consider regional and local contexts. Efficient metrics for assessing performance and impact are needed, and ethical issues like data privacy and technology misuse should be addressed. Research should also address power imbalances and promote fair resource distribution. Emergency crises require resilience and adaptation, and research should focus on building robust and flexible logistics systems that can adapt to dynamic conditions.

Collaboration among scholars, practitioners, policymakers, and communities is essential to develop more potent and streamlined systems.

4. CONCLUSION

This systematic literature review has thoroughly investigated the present state of research on Emergency Supply Chain Management, operational efficiency, and the traceability of supply chains. Through comprehensive analysis of a wide array of research, we have acquired useful knowledge on the different technologies, methodologies, and obstacles related to enhancing transparency, accountability, and efficiency in the delivery of emergency relief.

The examined papers emphasize the considerable potential of technologies like as blockchain, IoT, and RFID in improving traceability and transparency in emergency supply chains in providing public health service. Nevertheless, we have also highlighted other areas of insufficient understanding that must be resolved in order to fully use the capabilities of these technologies. Notable discoveries from this review include of the pressing requirement for more empirical investigation to authenticate theoretical ideas and evaluate the influence of technology in practical emergency operations. The significance lies in the seamless integration of many technologies to provide complete traceability systems. The crucial importance of human aspects and social environment in determining the effectiveness of Emergency Supply Chain Management and supply chain efforts. The paucity of studies about the enduring effects and viability of these systems. Enhanced collaboration and data exchange across stakeholders are necessary to optimize efficacy. The significance of taking into account regional and local settings during the process of planning and implementing solutions. The necessity for strong and uniform criteria to quantify the efficiency and influence of Emergency Supply Chain Management and supply chain systems. The key ethical concerns revolve on data privacy, surveillance, and the possible exploitation of technology in emergency contexts. The imperative to rectify power disparities and provide fair and equal access to resources within Emergency Supply Chain Management and supply chain systems. The pivotal importance of resilience and flexibility in the design of systems that can successfully respond to unforeseeable and dynamic emergency emergencies.

To summarize, this analysis showcases the notable advancements achieved in the field of Emergency Supply Chain Management, operational efficiency, and the study of traceability in supply chains. Nevertheless, it emphasizes the necessity for more investigation and advancement to tackle the recognized areas of little understanding and guarantee that technology is efficiently employed to enhance the well-being of individuals impacted by emergency emergencies

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