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Simwita, Yusta; Salema, Gladness

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Kontakt/Contact

ZBW – Leibniz-Informationszentrum Wirtschaft/Leibniz Information Centre for Economics
Düsternbrooker Weg 120
24105 Kiel (Germany)
E-Mail: [rights\[at\]zbw.eu](mailto:rights[at]zbw.eu)
<https://www.zbw.eu/econis-archiv/>

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Systematic Assessment of the Literature on Healthcare Supply Chain Sustainability Practices and Methodological Trends

*Yusta Simwita*¹

Lecturer, Department of General Management, University of Dar es Salaam, Dar es Salaam, Tanzania

Gladness Salema

Senior Lecturer, Department of General Management, University of Dar es Salaam, Dar es Salaam, Tanzania

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Abstract

The ever-growing uncertainties and complexities in health supply chains attract the need to implement sustainability practices in their operations. This study applies a systematic literature review to conduct a comprehensive review from 2008-2023 to identify commonly used sustainability practices and methodological trends. After a comprehensive analysis, 31 articles were included in the final analysis. We observed that several sustainability practices in all three sustainability pillars had been implemented in the healthcare supply chain. This includes employee welfare and well-being, understanding and managing demand, and green practices. This review found that sustainable practices have great benefits, such as empowering employees and increasing the performance and efficiency of an organization. Also, this review observed that several methodologies are being used in the healthcare supply chain, whereby empirical studies are more than conceptual studies. In empirical studies, the in-depth interview is the most used methodology compared to other methods. This observation shows a clear methodological gap in the healthcare supply chain sustainability, as more of the existing research concentrates only on the in-depth interview. This study sheds light on policymakers growing awareness for the benefit of implementing sustainable practices for improved healthcare supply chain performance. From the researcher's perspective, this review sheds light on the areas that need further investigation, such as social sustainability, which is not well-researched in the healthcare supply chain.

Keywords: *Healthcare supply chain, sustainability, healthcare, content analysis.*

¹ Corresponding Author: simwita2009@gmail.com

Introduction

Beginning in the late 1990s and picking up steam at the turn of the new century, health supply chain (HSC) research has been ongoing. In many research studies, the main emphasis was on supply chain operations, inventory management, lean and agile operation, and information technology, while employee and customer training, tracking and visibility of medications, cold chain management, human resource practices, risk management, and waste management were found to be the important issues. However, much work hasn't been done in HSC, particularly on sustainability (Dixit et al., 2019). Sustainability is a multidimensional concept that comprises economic, societal, and environmental objectives and covers a triple bottom line (economic, environmental, and social) of any business (Hussain et al., 2018; Carter&Roger 2008).

Recently, governments, funders, and healthcare managers have shown a growing interest in the importance of sustainability in the health supply chain. The healthcare supply chain has been defined as the flow of information, various health commodities, and medicine across various healthcare facilities (John, 2021). Conceptually, healthcare supply chain sustainability is defined as the strategic, transparent integration and achievement of an organization's social, environmental, and economic goals in the systemic coordination of key inter-organizational business processes for improving the long-term economic performance of the individual company and its supply chains (Carter & Rogers, 2008). This comprehensive definition indicates that sustainability is the product of three economic, environmental, and social pillars.

Governments are under critical pressure to sustain their economies, environment, and societies in the healthcare supply chain(Khan et al., 2018). Inefficient product and service deliveries, rising storage and logistics costs, and declining profitability are just a few of the economic sustainability concerns facing the healthcare supply chain today (Duque-Urbe et al., 2019). From a social sustainability perspective, Chen et al. (2013) identified social sustainability implications with non-standard employment (tenured contract), pay level differentials compared to other economic sectors, glass ceiling, and women marginalization issues in daily work. To eradicate these inefficiencies, sustainability becomes no longer an option but a critical component of various healthcare operations (Molero et al., 2021). Different management practices are put into place by organizational managers in order to satisfy sustainability standards. According to Duque-Urbe and colleagues (2019), management practices are organizational behaviors or actions that promote sustainable growth throughout the supply chain. Examples include customer and supplier relationship management, logistical operations, and supplier relationship management (ibid).

Adopting sustainability practices is crucial to prevent distortion of the resources. Although healthcare protects and improves human health, the demand for integrating sustainability practices in healthcare is increasing because their structures can negatively affect human well-being and the environment (Elabed et al., 2021; Molero et al., 2021). There is an increasing concern regarding resource overconsumption, environmental degradation, and social inequity in the healthcare supply chain. These concerns lead to a more sustainable society, economy, and environment. Thus, the urge to integrate sustainability into the healthcare supply chain is increasing and is associated with challenges related to the complexity of healthcare supply chains (Anåker & Elf, 2014; Elabed et al., 2021).

Studying sustainability in healthcare is complex due to the complex nature of healthcare operations systems. The three dimensions of sustainability (economic, social, and environmental) are also multidimensional, making it difficult to measure them under the same analytical framework. Sometimes conflicts arise within the same dimension (e.g., individual vs. collective interests within the social dimension) or between dimensions (e.g., the environmental and economic dimensions relating to cost aspects) (Hussain et al., 2020; Khosravi et al., 2019; Winter & Knemeyer, 2013). However, despite these complexities, several approaches have been used to study sustainability concepts in supply chain management. Some of these methods include case studies, conceptual and theoretical framework development, modeling, and surveys (Carter & Rogers, 2008; Seuring & Müller, 2008; Winter & Knemeyer, 2013). In the healthcare supply chain sustainability context, similar approaches have been used to study sustainability (Carter & Rogers, 2008; Jæger et al., 2021). Thus, it's imperative to critically analyze the common methodologies used to study sustainability in the healthcare supply chain.

Despite the extensive growth of supply chain management sustainability literature, the supply chain management gap is still evident in healthcare. Notwithstanding the importance of supply chain management and sustainability in healthcare settings, studies in this category have addressed these two concepts in a fragmented way (Duque-Urbe et al., 2019). There is a lack of systematic reviews that have addressed the intersection between healthcare supply chain sustainability practices and methodological trends. Most existing reviews on the healthcare supply chain focus on economic aspects, not clearly including environmental and social issues (Khan et al., 2018; Molero et al., 2021; Winter & Knemeyer, 2013). There is a lack of thorough literature reviews that concentrate on the three pillars of sustainability in the fields of sustainable practices, focusing on their methodological trends

Against this background, the main contribution of this paper is to explore common sustainability practices used in healthcare supply chains and methodological trends. A systematic review approach was employed to establish common sustainability practices and methodologies used in healthcare supply chain research. The following research questions guide this review:

RQ1: Which sustainability practices are applied in the healthcare supply chain?

RQ2: What methodological approaches are employed in research on the sustainability of the healthcare supply chain?

This study article is supposed to alert academics to current knowledge gaps in healthcare supply chain sustainability. The extent to which sustainability practices are applied in health supply chains to provide better access to high-quality medical care is a key discussion point for policymakers and development partners in the health sector. Therefore, the importance of sustainability in the health supply chain cannot be understated, given its impact on efficacy and efficiency. It has been regarded as a crucial element in trash minimization.

This paper is organized as follows: the next section presents the sustainability concept and the methodology section. After that, the results and discussion section is presented, followed by the conclusion and recommendation section.

Sustainability in Healthcare Supply Chain Management

The sustainability concept was first introduced after the publication of "Our Common Future" report in 1987 by the United Nations. After this publication, the sustainability concept started to be integrated into various theoretical policies and managerial practices (Mostepaniuk et al., 2023). Since its evolution over two decades ago, numerous academics and practitioners have proposed multiple definitions. The widely used definition is the one proposed by The World Commission on Environment and Development entitled 1987 "our common future", defined sustainability as "using resources to meet the needs of the present without compromising the ability of future generations to meet their own needs." (WCED, 1987 – Brundtland Commission).

The multidimensional concept of sustainability (Triple Bottom Line 3TBL) was introduced around mid-1990. This concept highlights that corporations' focus should be based not only on the economic value they add but also on social and environmental aspects (Elkington, 2004). The environmental dimension involves the set of objectives, plans, and mechanisms that stimulate greater environmental responsibility and encourage the development of environmentally friendly technologies (Klassen, 2001). On the other hand, the social dimension includes a set of basic human needs that should be supplied without harming nature and its regenerative abilities over time (Hussain et al., 2019; Konovsky & Pugh, 1994). It also refers to protecting and developing internal organizations in terms of human and social capital. External aspects of social sustainability focus on issues related mainly to strategic management processes and public perception reports (Khosravi et al., 2019). Economic sustainability is defined as an organization's ability to earn revenue to manage its operations (Sharma & Tripathi, 2022) It is primarily quantitative in nature, and it involves aspects such as the efficient use of resources for profit-making (Winter & Knemeyer, 2013) (Rumelt, 1974).

The Triple Bottom Line (TBL) concepts and healthcare supply chain management sustainability have become significant (Duque-Urbe et al., 2019). Healthcare supply chain sustainability refers to the inclusion of environmental and social dimensions in the conventional notion of SCM and is defined as "the management of material, information, and capital flows as well as cooperation among companies along the supply chain while taking goals from all three dimensions of sustainable development, i.e., economic, environmental, and social, into account, which are derived from customer and stakeholder requirements." (Seuring & Müller, 2008, P. 1700). Hospital supply chains are complex and always characterized by economic, environmental, and social difficulties. From an economic perspective, increasing healthcare expenditures requires better efficiency in delivering care services (Kumar & Blair, 2013; Weisz et al., 2011). With regard to the environmental dimension, healthcare delivery processes consume a lot of material, energy, and water, which generates significant amounts of waste (Duque-Urbe et al., 2019; McKone-Sweet et al., 2005; Pisters et al., 2017; Zhu et al., 2018).

Like any other organization, hospitals are not exceptional regarding social problems. As internal customers, employees face several social issues, such as decreased pay levels compared to other economic sectors, daily working hours exceeding legal limits, and neglected safety considerations (Manyisa & van Aswegen, 2017). Additional social problems for healthcare workers include but are not limited to long working hours due to increased patient demand,

which leads to occupational accidents, develops burnout, and additional psychological stress (Duque-Urbe et al., 2019; Weisz et al., 2011).

This background entails that sustainability triple bottom line dimensions are critical to better delivery of healthcare services. The triple challenge of being economically efficient, more environmentally friendly, and offering better conditions to workers and communities served can be accomplished by using sustainability practices (Duque-Urbe et al., 2019). Thus it's critical to assess the sustainability practices that are being used in the healthcare supply chain. Sustainability is a complex multidimensional concept; thus, studying this concept is also complex. Extant literature indicates that it is not easy to measure the three sustainability dimensions in the same analytical framework due to the complexity of each dimension because each dimension is multidimensional (Winter & Knemeyer, 2013). Given the complexity of healthcare supply chains, assessing the common methods used to study sustainability practices in this research domain is critical.

From a sustainability practices perspective, some extant literature raises several barriers, motivators, and drivers for implementing sustainability practices in the healthcare supply chain. The argument behind these is that the healthcare supply chain is a complex system that cannot be handled like manufacturing and other service industries. Thus, it's not surprising that obstacles hinder the implementation of these practices in the healthcare supply chain. Barriers such as not having supportive institution or infrastructures, Lack of awareness of healthcare actors, and Lack of sustainability innovations technologies has been well articulated by some authors ((Khan et al., 2018))

Methodology

This study adopted systematic literature review approach to achieve the study objectives. The systematic literature review approach offers several advantages compared to the traditionally structured reviews. Systematic literature review (SLR) adopts a replicable and transparent process that leads to: the minimization of bias and errors (Tranfield et al., 2003); improves the quality of the review process and outcomes (Mihalache & Mihalache, 2016); endorses the validity of the review process through the replication of clear steps during the review process (Wang & Chugh, 2014); and enabling generalizability of the results through systematically synthesizing and organizing accumulated literature in a specified research field (Wang & Chugh, 2014), It is with the preceding reasons we consider SLR the most appropriate methodology for this study. Given the objective of this study, a systematic literature review facilitates a clear understanding of the discussion of collected literature from 2008-2023. 2008 was a starting point because no article was obtained beyond this year. This implies that sustainability research emerged in the healthcare supply chain around this timeframe.

To determine the sustainability practices and methodological trends, the search for articles that incorporate healthcare supply chain sustainability was chosen as the search technique to find these terms. The sample for this study comprised papers from English-speaking journals for the period covering 2008-2023. To have a comprehensive and exhaustive search, we focused on major databases first, and by tracing references, more databases were added, making a total of five databases. The literature search was done in the following major databases: Emerald Insight, Wiley, Google Scholar, Science Direct, and Taylor and Francis. These databases were

selected due to their comprehensive coverage and easily accessible and have been extensively used by other studies (Winter & Knemeyer, 2013).

To ensure that the most relevant papers are included in the review, a literature sample was carried out using paired keywords as follows: "sustainability and healthcare supply chain", "social sustainability and healthcare supply chain", "environmental sustainability and healthcare supply chain", and "economic sustainability and healthcare supply chain". For each database, the following steps were followed to search the articles. In the first phase, we selected papers using outlined keywords at a time; for example, sustainability and healthcare supply chain" were used in the first stage. The second keyword was used after checking all the databases with these keywords. These keywords were found to be used either as a keyword, abstract, or title in a selected article. Even though healthcare supply chain sustainability has been researched in healthcare, these keywords didn't comprehensively search all the articles. Thus, the second phase involved checking on references of each reviewed article. Pairing keywords found in references were retrieved for further review whenever possible. Papers with these joint words were included in the sample.

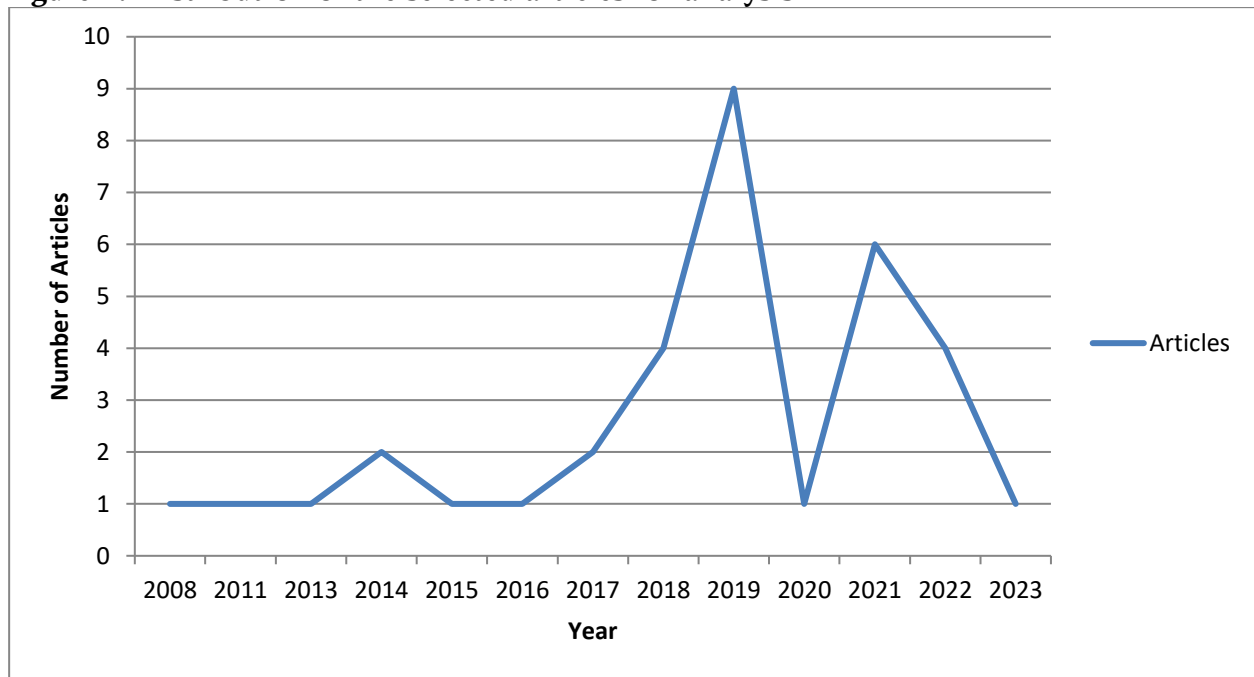
From 2008-2023, 19 articles in Emerald Insight, 8 articles in Wiley, 21 articles in Science Direct, 17 in Google Scholar, and 12 in Taylor and Francis were obtained. For all these databases, a total of 77 articles were obtained. The first step was to remove duplication, whereby 61 papers remained. To exclude papers that did not meet the needs of the current research, we limited the initial review to the title and abstract. Under these criteria, a total sample of 56 articles was included for a comprehensive review. The second round involved reading the introduction, and all articles that included just the term healthcare supply chain without sustainability were not included. At this stage, only 43 articles met the criteria. The final round involved reading the entire article and articles that included sustainability but lacked a healthcare supply chain were not included in the final analysis. At this stage, 31 articles (see Table II) met the final inclusion criteria and were included in the analysis. Articles that did not meet the selection criteria were excluded as shown in Table I below. Figure I presents the descriptive presentation of the collected data. The sharp increase in 2018 and 2019 indicates that healthcare supply chain sustainability is a topical research that is getting great scientific attention. Specifically, this time was due to Covid 19, whereby healthcare supply chain actors focused on implementing sustainable practices to maintain healthcare system resilience during this disruption. This attracted more studies to conduct research in this area (Ali et al., 2023; Derqui et al., 2021).

All published articles between 2008 and 2023 were selected for further analysis for potential inclusion in the final analysis. The primary criteria for including an article, in the final analysis were establishing a clear connection of the article content to the sustainability dimensions and healthcare supply chain management. A total of 31 publications were used for further analysis as a result of a review process. Table II presents the details of these articles, such as their focus, practices, and methodologies, and the methodological trends used in healthcare supply chain sustainability. Before further analysis, each term in sustainability practices and methodological trends was carefully reviewed. To maintain this paper's credibility and trustworthiness, external personnel were given the work to determine rigor. Any disagreement with that person was settled, for example, on inclusion or exclusion criteria.

Table 1: Inclusion and Exclusion criteria

Criteria	Inclusion	Exclusion
1. Language	English-speaking journals only	Articles using other languages
2. Publication Type	Conceptual and empirical	Articles based on magazines, newspapers
3. Coverage or Scope	Articles focusing on healthcare supply chain sustainability, environmental sustainability, social sustainability, economic sustainability	Articles focusing on healthcare supply chains lacking sustainability

Figure 1: Distribution of the selected articles for analysis



Results and Discussion

After applying the proposed search strategy and selection criteria, 31 articles were included in the final analysis (Table 2). Generally, 77 articles were found in the database, of which 16 were duplicates, and 17 were excluded for not meeting the inclusion criteria. It is worth noting that 24 articles (77% of all articles in the final analysis) covered all three dimensions of sustainability (economic, social, and environmental sustainability). The remaining seven articles (22.5 %) covered either of the three dimensions). This section is divided into three parts. The first presents the outcomes of addressing question one, which presents the sustainability practices used in the healthcare supply chain. The second part addresses question two by presenting the methodologies commonly used to study sustainability in healthcare supply chain. The first and second section also presents sustainability practices and their effect on healthcare supply chain management for explaining the relationship based on qualitative

and quantitative findings reported in the reviewed literature. The third section presents the emerging issues observed during this process, followed by the section on areas for further research.

Common Sustainability Practices in the Healthcare Supply Chain

The healthcare supply chain concept is well articulated in the reviewed literature. Different approaches have been used to describe the concept; for example, Hussain et al. (2018) elaborate on the healthcare supply chain as a concept that comprises an internal chain (e.g., patient care unit, hospital storage, and patient) and the external chain (e.g., manufacturers, and distributors). These authors further highlight that the healthcare supply chain combines different activities and operations that assimilate a smooth flow of products and services for healthcare. Some authors describe healthcare supply chain management as a concept comprising elements such as customer satisfaction, demand, customer relationship, capacity and resources, and supplier relationship (Leksono et al., 2019).

In addressing the first research question, practices from the three sustainability dimensions were reviewed. The results of each dimension are presented below.

Social Sustainability Practices

This review found that social sustainability practices are well articulated in the literature, with nine categories of practices identified during the review. These practices include change management, accountability and auditing practices, collaboration and corporation, employees' welfare and well-being, patient-centered vision and goals empowerment and engagement, patient satisfaction, fairness, and justice, effective leadership and management practices, customer service, equity, and justice (Aliakbari Nouri et al., 2020; Derqui et al., 2021; Hussain et al., 2018; Khan et al., 2018; Khosravi et al., 2019)

The research in this dimension of sustainability asserts that proper cognizance of social sustainability practices within the healthcare supply chain leads to overall sustainability. It is stated that healthcare practitioners can benefit considerably by imbibing social interactions, which aids in gaining people's trust and credence (Hussain et al., 2018; Khosravi et al., 2019). Some authors found stakeholders such as suppliers, patients, patients' relatives, employees, and governments play a prominent role in enhancing sustainability in healthcare supply chain. Practices such as empowering employees and fulfilling their related requirements were found to positively impact sustainability. From the patients' perspective, patient safety and relationship management are commonly used and help strengthen sustainability in the healthcare supply chain (Aliakbari Nouri et al., 2020; Khan et al., 2018; Khosravi et al., 2019).

To achieve social sustainability in the healthcare supply chain through stakeholders, healthcare actors are urged to make some initiatives, such as collaborations, because one stakeholder can deteriorate the entire supply chain (Khan et al., 2018). These studies found that the significant impact of social activities cuts across all the participating (stakeholders) irrespective of the projected sustainability value obtained for each of them. This implies that adjusting one practice in the chain produces a ripple effect on the entire healthcare supply chain. Therefore,

the healthcare supply chain actors should focus on the holistic improvement of social sustainability practices in the entire supply chain (Derqui et al., 2021; Hussain et al., 2018; Khan et al., 2018; Khosravi et al., 2019).

From a social sustainability perspective, research highlights some practices as the top three since they are widely used in the healthcare supply chain. These practices include patient-centered vision and goals, patient satisfaction, and gaining close attention to services are the top three motivating practices in a healthcare supply chain (Hussain et al. 2018). Research sees governments and healthcare practitioners as critical stakeholders who play a significant role in fostering and establishing social sustainability practices such as employee well-being, patient satisfaction, effective leadership, and management practices. Many authors have argued the aforementioned social practices have a positive effect on healthcare supply chain sustainability (Derqui et al., 2021; Hussain et al., 2018; Khan et al., 2018; Khosravi et al., 2019)

Scientific literature concludes that a comprehensive analysis of stakeholders' opinions regarding the factors that constitute a socially sustainable supply chain would help hospital managers balance the expectations of all involved parties by obtaining the highest benefits at the lowest costs (AlJaberi et al., 2020; Hussain et al., 2018)

Despite the critical importance of social sustainability in the healthcare supply chain, some empirical findings argue that social sustainability is not given the same weight as economic and environmental dimensions. The dearth of empirical research in the healthcare supply chain is evidenced by several peer-reviewed literature (AlJaberi et al., 2020; Hussain et al., 2019). As stated in the preceding paragraph, a comprehensive analysis of what constitutes social sustainability in healthcare supply chains from various stakeholders could help the fast adoption of these dimensions.

Economic Sustainability Practices

There are numerous economic sustainability practices in the reviewed scientific literature concerning their relationship with healthcare supply chain sustainability. Under this dimension 13 categories of commonly used practices emerged, namely demand management, resource and capacity management, customer relationship management, supplier relationship management, service management, information management, financial performance management, attention to energy consumption, legal requirements, employees, community and stakeholders, social accountability, and business ethics (Aliakbari Nouri et al., 2019; Derqui et al., 2021; Elabed et al., 2021; Hussain et al., 2018; Karbassi Yazdi et al., 2022; Mirghafoori et al., 2018; Nagariya et al., 2021; Ramish et al., 2017; Rico & Oruezabala, 2013). According to the reviewed studies, healthcare actors implementing these practices have a better realization of a sustainable healthcare supply chain.

Studying the relationship between economic sustainability practices in the healthcare supply chain, a study by Vishwakarma et al. (2022) found that adopting sustainable supply chain economic practices improves healthcare sustainability, which, in turn, positively influences the circular economy. Within the same line, a study (2021) concluded that cost-saving opportunities comprise practices that aim to improve sustainability in healthcare supply chain. Economic issues such as higher expenditures, limited resources, and high energy consumption are critical issues affecting healthcare supply chains. As a result of several economic practices

such as capacity and resource management, service management, attention to energy consumption, and financial performance management have been suggested by reviewed literature as practices that improve sustainability in healthcare supply chain.

Empirical studies have proven that implementing economic practices leads to financial and consumption savings and the general well-being of the whole population (Mirghafoori et al., 2018; Ramish et al., 2017; Rico & Oruezabala, 2013). The reviewed literature further argues that increasing healthcare expenditures requires greater efficiency in delivering healthcare services (Landry et al., 2016). Hospitals are estimated to account for approximately 40% of the total healthcare sector expenditure. The empirical findings of reviewed studies found that approximately 30 to 40% of the healthcare budget is dedicated to healthcare supply chain costs. An interesting finding is that the healthcare supply chain cost can be reduced by the use of best economic sustainability practices such as financial management, resource, and capacity management, thus improving sustainability (Landry et al., 2016; Mirghafoori et al., 2018; Nagariya et al., 2021). A study by Hussain et al. (2018) found that healthcare sectors have paid more attention to economic sustainability practices than social sustainability practices. Extant literature found that improving economic sustainability practices significantly impacts social and environmental sustainability. Thus, healthcare practitioners are argued to focus on enhancing economic sustainability (Elabed et al., 2021; Landry et al., 2016). Although the healthcare sector is argued to focus more on economic sustainability, some reviewed studies argue that economic sustainability is not intensively studied in the healthcare supply chain (Derqui et al., 2021).

Environmental Sustainability Practices

Some reviewed studies indicate that sustainability research in healthcare is dominated by environmental components (Hussain et al. 2018). Under this dimension, environmentally friendly nine categories of practices emerged, such as trash management, waste recycling practices, and transformation of material (Ahsan & Rahman, 2017; Balan & Conlon, 2016; Benzidia et al., 2021; Jæger et al., 2021; John, 2021; Karbassi Yazdi et al., 2022; Mirghafoori et al., 2018; Rico & Oruezabala, 2013; Scavarda et al., 2019; Vishwakarma et al. 2022; Zhu et al., 2018) and green practices which include waste reduction and greenhouse gas emissions, eco-design, green purchasing, ecological packaging, and reverse logistics in the supply (Ahsan & Rahman, 2017; Balan & Conlon, 2016; Bentahar et al., 2023; Jæger et al., 2021; Vishwakarma, Dangayach, Meena, Gupta, & Luthra, 2022).

Similarly, studies on environmental practices have concluded the existence of a positive relationship with the healthcare supply chain sustainability concept. In this context, the positive effect of environmental practices such as waste management, green purchasing, and ecological packaging chain has been argued as the key motivator for the implementation of sustainability practices in the pharmaceutical supply chain (Derqui et al., 2021; Vishwakarma et al. 2022). 'For example, studies in the pharmaceutical supply chain found that reducing the pharmacy's environmental footprint and minimizing waste are the main motives for implementing sustainability initiatives in this field (Derqui et al., 2021; Hussain et al., 2020). Research under this dimension concluded that increasing awareness of environmental practices such as waste management and green gas emissions to the actors in the healthcare supply chain positively impacts sustainability (Derqui et al., 2021; Mirghafoori et al., 2018).

Despite the above practices, research under the environmental sustainability dimension argues that environmental sustainability is not well practiced in the supply chain of many industries (Suhi et al. 2019). In the healthcare context, the implementation of environmental sustainability has lagged. Studies highlight that hospitals focus more on activities that enhance internal operations than environmental sustainability (Zhu 2018). The significant finding from the reviewed literature further indicates that hospital environmental efforts are internally proactive-oriented and eco-efficiency-focused. Findings in some of the reviewed studies indicate limited engagement of the healthcare sector to the external greening pressures from market competitors (e.g., other hospitals), partners (e.g., external supply chain vendors), or consumers (e.g., patients) (Zhu et al., 2018).

Despite the lagging adoption of environmental sustainability, healthcare supply chain practitioners are facing pressure to increase the greening of hospitals, digging deeper into the triple-bottom-line of people, planets, and profit (Kagoma, Yoan; Stall, Nathan; Rubinstein, Edward; Naudie, 2012).

Methodologies Deployed to Study Sustainability in the Healthcare Supply Chain

In addressing the second question, several methodologies used to study sustainability in the healthcare supply chain have been identified in the reviewed literature. These include qualitative methods such as exploratory analysis case studies, quantitative methods such as structural equation modeling, mathematical modeling, multi-tier supply chain modeling, interpretive structural equation modeling, multi-criteria decision analysis, and stochastic exponential distribution. Analysis of common methods for sustainability practices shows that multi-tier supply chain modeling and interpretive structural modeling have been employed. These methods are widely applied due to their power to address complex constructs (Hussain et al., 2019; Khan et al., 2018; Nagariya et al., 2021; Vishwakarma et al., 2022). According to (Hair et al., 2021), structural equation modeling is a powerful approach for analyzing complex relationships among constructs and indicators.

Table 2: Literature Synthesis

Author	Economic sustainability	Social sustainability	Environmental sustainability	Method	Database
Ahsan & Rahman (2017).			√	Analytic hierarchy process (AHP)	Science Direct
Aliakbari Nouri 2020	√	√	√	Expert interview	Emerald
Aliakbari Nouri 2019	√	√	√	Interpretive structural modeling (ISM) and Fuzzy Delphi Method	Emerald
Bentahar, et al 2023			√	Qualitative multiple-case study	Emerald
Benzidia et al2021			√	Big data analytics and artificial intelligence	Science Direct
Derqui,et 2021	√	√	√	Exploratory analysis	Science Direct
Elabed et al. 2021	√	√	√	Multi-criteria decision-making method (MCDM)	Science Direct

Author	Economic sustainability	Social sustainability	Environmental sustainability	Method	Database
Hussain et al. 2018		√		Qualitative	Science Direct
Jæger, et al 2021	√		√	Multi-tier supply chain modeling	Emerald
Karamat et al. 2019	√	√	√	Interpretive structural modeling (ISM).	Google Scholar
Yazdi et al. 2022	√	√	√	Multiple-Criteria Decision Analysis	Google Scholar
Khan et al. 2018		√		A structural model	Science Direct
Khosravi et al. 2019		√		Stochastic exponential distribution	Google Scholar
Leksono et al. 2019	√	√	√	Balanced Scorecard, DEMATEL, and ANP	Google Scholar
Mirghafoori et al 2018	√	√	√	Depth interview, Delphi methods	Google Scholar
Molero, et al 2021	√	√	√		Google Scholar
Nagariya et al. 2021	√	√	√	Interpretive structural modeling (ISM) and fuzzy decision-making trial and evaluation laboratory (DEMATEL) technique.	Emerald
Ramish et al. 2017		√	√	Comparative analysis of models	Google Scholar
Rico, & Oruezabala 2013	√	√	√	Qualitative approach	Taylor & Francis
Tooranloo & Rahimi, 2018	√	√	√	Interpretive structural modeling (ISM).	Google Scholar
Scavarda et al. 2019	√	√	√	Qualitative	Science Direct
Subramanian et al 2020	√	√	√	Develop index	Google Scholar
Tseng et al. 2022	√	√	√	Fuzzy Delphi method	Taylor & Francis
Vishwakarma et al., 2022a	√	√	√	Structural equation modeling	Emerald
Vishwakarma et al., 2022b	√			structural equation modelling	Emerald
Vishwakarma et al, 2023	√	√	√	interpretive structural modelling	Springer
Zhu et al 2018			√	Analytic hierarchy process (AHP)	Taylor & Francis
Landry et al. 2016	√			Case study	Science Direct
Weisz	√	√	√	Qualitative	Google Scholar
Balan & Conlon, 2016			√	Experimental analysis	Google Scholar
Kagoma et al. 2012	√	√	√	Qualitative	Google Scholar

An interesting finding is that most of the empirical study is very current, within five years; this indicates that healthcare supply chain sustainability is an emerging concept that still needs

more studies. Among the recent events that increased the number of empirical studies in the healthcare supply chain is the disruptions of covid 19, whereby most researchers focused on assessing how sustainable is the healthcare supply chain during this covid 19 era (Ali et al., 2023). Furthermore, this increase in empirical studies might also indicate that many healthcare organizations are implementing these practices; thus, researchers are studying to explore various issues, such as the effect of these practices on healthcare operations.

Emerging issues

During this review, three issues emerged: sustainability-oriented innovation in healthcare supply chain, motivators of social sustainability, and barriers and enablers of economic, social, and environmental sustainability practices implementations. It is worth noting that this review observed that even though several sustainability practices are being implemented in the healthcare supply chain, their positive impact is not straightforward. These practices are characterized by several issues, such as barriers, motivators, and the need for innovations to successfully realize the advantage of implementing these practices. A more detailed discussion is presented hereunder.

Sustainability-oriented Innovation and Blockchain technology

Reviewed studies emphasized the importance of sustainability-oriented innovation and blockchain technology practices in healthcare supply chains (Elabed et al., 2021; Kinney, 2010; Vishwakarma et al., 2023). They found that the healthcare industry faces challenges in integrating sustainability in supply chains. Healthcare studies should focus on implementing sustainability-oriented innovation and blockchain technology to eradicate these challenges.

Empirical findings reveal that participants in these studies ranked "sustainability-related training," "availability of technical expertise," and "medical waste management." as the top three most important practices that enhance the achievement of sustainability-oriented innovation in the healthcare supply chain. The least three linked practices in this research were "resource allocation," "supplier relationship management," and "transportation and storage." The most important practice or criteria that enhance the achievement of sustainability-oriented innovation, as ranked by the participant in this study, was "Sustainability-related training." This finding suggests that healthcare managers consider conducting training for medical professions of high necessity because it enables incorporating SOI into professional practice (Aliakbari Nouri et al., 2019; Elabed et al., 2021; Kinney, 2010)

Despite the importance of blockchain technology in enhancing suitability in the healthcare supply chain, the reviewed studies found some associated challenges in adopting this technology. The most common challenges are economic challenges, stakeholder commitment, and careful Lack of government intentions to promote blockchain technology in supply chain management) and poor infrastructure for the adoption of block chain technology (Vishwakarma et al., 2023; Vishwakarma et al. 2022). To attain improved sustainability in the healthcare supply chain, healthcare actors should focus on improving blockchain technology.

Motivators of Social Sustainability

Another stream of studies focuses on the motivators of social sustainability in the healthcare supply chain. Using confirmatory analysis, a study by Khan et al. (2018) found five major

dimensions, namely, organizational practices, media and reputation, excellence and awards, technology and innovation, and attitudes, as the key motivators of social sustainability in healthcare supply chains in the UAE. These Organizational practices and attitudes are found to have the highest and lowest impact, respectively, on the motivation for social sustainability. A study by (Hussain et al., 2019) found that Organizational Practice Media and Reputation, Excellence and Awards, Technology and Innovation, and Attitude) and 34 subcategories as the critical drives of social sustainability in healthcare supply chain. In this study, the analytical hierarchy process assigned the highest priority to media, reputation, and organizational practice. The interesting finding in both studies is that organization practices remain a high priority, indicating that healthcare managers should focus more on improving organization practices to enhance the achievement of healthcare supply chain sustainability.

Barriers and Enablers of Sustainability Practices Implementations

In an emerging field, it's common to find scholars focusing on issues such as barriers and enablers of a particular area of study—a study by identified barriers to implementing social sustainability in healthcare supply chain. The most common obstacles these authors pose include infrastructure, organizational culture, Lack of coordination, stakeholder disparity, and uncertainty. The empirical findings assert that these barriers are positively and highly correlated measurement barriers to social sustainability practices implementation (Karbassi Yazdi et al., 2022; Khan Mehmood, Ajmal Mian, Hussain Matloub, 2017; Nagariya et al., 2021; Sayyadi Tooranloo & Rahimi, 2018). A study by Tooranloo & Rahimi (2018) identified fifteen barriers to implementing sustainability practices in healthcare supply chains. Among those fifteen barriers, this study highlights some barriers that are most important in implementing a suitable supply chain in healthcare compared to other barriers. This includes the Lack of senior management's commitment to initial attempts of sustainability, the Lack of knowledge among the supply chain members, the Lack of expert human resources, and unawareness of society about social ways. Within the same theme, a study by Karbassi et al. (2022) found that barriers such as Lack of legislation, Lack of sustainability awareness, and Lack of skilled workforce affect the implementation of sustainability in healthcare supply chain. Contrary to other studies, this study also found some economic factors that negatively affect the use of sustainability practices in the healthcare supply chain; these factors include high sustainability and disposal costs. Further, these reviewed studies found that Lack of management support, Lack of waste management technology, and limitation of knowledge have a negative impact on implementing sustainability practices.

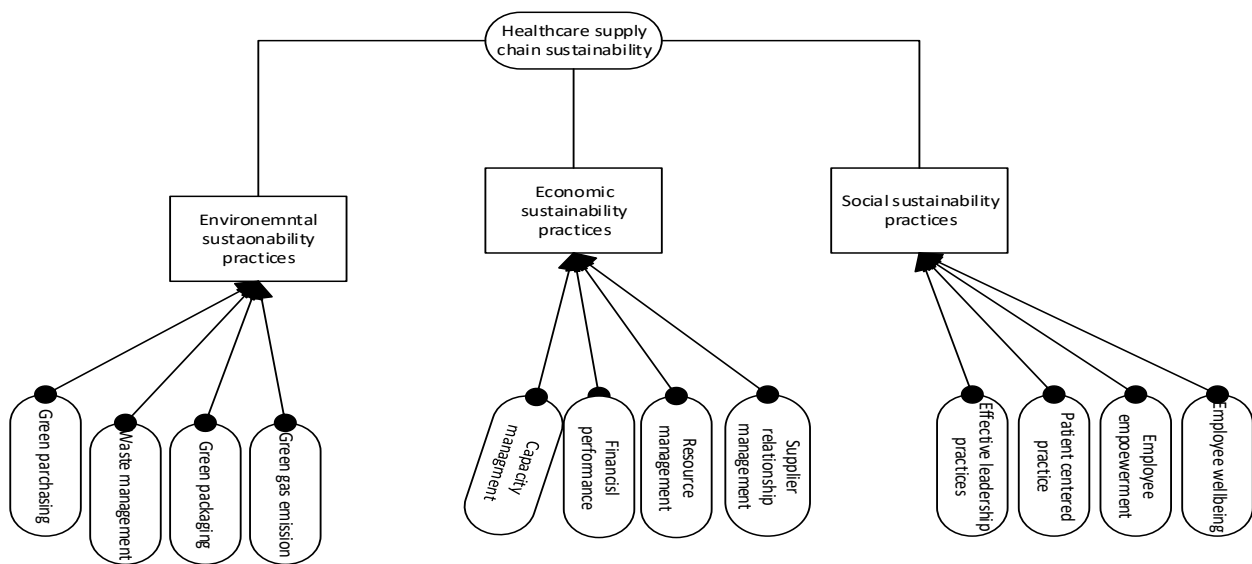
Studies were found proposing some enablers to implementing a healthcare-sustainable supply chain. One of the enablers suggested by the reviewed studies is that all beneficiaries in the supply chain should collaborate and coordinate due to the proximity of barriers. For example, the importance of management role barriers determines the staff's expertise and knowledge in sustainability and society's attention to implementing sustainable supply chain management. Any change in these barriers affects the other barriers, too; thus, collaboration is the key.(Nagariya et al., 2021; Sayyadi Tooranloo & Rahimi, 2018).

From a stakeholder's theory perspective, a study by Hussain et al. (2019) focused on four stakeholder groups in the healthcare supply chain: suppliers, employees, patients/community, and owners/government. Contrary to other studies, these authors focused on social sustainability. However, the findings still have similar conclusions. This study confirmed that,

while separate attention to each stakeholder group is important, healthcare actors should still focus on comprehensively analyzing all stakeholders' perceptions of what constitutes a socially sustainable supply chain, which would offer more benefits and help hospital managers balance the expectations of all involved parties. (Hussain et al., 2019)

This study's key objective is to assess the practices that facilitate sustainability in the healthcare supply chain based on the previous scientific literature. The detailed analysis of prior literature allowed this present review to present the most common and tested practices in different contexts of the healthcare sector for further testing in the healthcare supply chain field and other service sectors. Figure II presents the hierarchical framework that can be further tested.

Figure 2: Conceptual Framework on Sustainability Practices in Healthcare Supply Chain



Conclusion

The main goal of this analysis was to conduct a systematic literature review on health supply chain sustainability. We analyzed a total of 31 articles. All these papers were included for analysis. The key finding in this study is that sustainability in the healthcare supply chain and operations is still not comprehensively researched. This paper established that all three dimensions of sustainability, economic, social, and environmental practices, have been employed in health supply chain sustainability research; however, environmental sustainability is dominant compared to economic and social sustainability. Regarding the methodology employed in sustainability practices, existing evidence has been generated through quantitative, qualitative, and mixed methods. Studies on sustainability implementation factors mainly employed mathematical modeling techniques.

This review offers several contributions to healthcare actors, academicians, and practitioners. This review brings awareness to healthcare supply chain actors on issues like motivators and barriers to implementing sustainability practices in the healthcare supply chain. This helps healthcare actors be aware of the challenges faced in implementing sustainability practices and how to handle those challenges from different stakeholders' perspectives.

This study is not without limitations; the main limitation of this study is that it focused only on English-speaking journals, neglecting other languages that might have contributed more to this study. Further studies can embed a multilingual approach to obtain comprehensive contributions. Despite this limitation, this study still contributes largely to healthcare supply chain sustainability by bringing awareness to the most common practices used in the supply chain.

The first possible area for further research is that the reviewed literature on barriers and motivators failed to designate the validity of identified factors in other service supply chains. More focus on the identified barriers and motivators has been on social sustainability; further research can explore more in economic and environmental sustainability. A comprehensive analysis of factors that inhibit the implementation of the triple bottom line of sustainability practices can improve sustainability in the healthcare and service industry.

The second avenue for further research lies in the lack of comprehensive measurement of sustainability practices. Measurement of sustainability in the healthcare supply chain is still fragmented. Few studies have tried to focus on this, with a limited focus on social sustainability. Given the complex nature of healthcare supply chains, viable frameworks that can measure complex healthcare supply chain sustainability are of critical importance.

The reviewed research is more dominant in higher-level hospitals, particularly public hospitals, with less focus on private and low-level hospitals such as health centers and district hospitals. Given that hospital supply chains cover all hospital levels, future research can be conducted in these lower level hospitals to examine the extent to which they practice sustainability practices. This will bring awareness to the owners of private and low-level hospitals on which sustainability practices are supposed to be implemented. Furthermore, a comparison study can be done to compare the sustainability practices, for example, at a referral hospital if the same must also be implemented at a low level hospital such as a health center.

Given the complexity of healthcare supply chain management, further research can focus on analyzing the effect of implementing social, economic, and environmental practices in the healthcare supply chain to its daily operations, such as treatment activities. There is a shortage of research in this area, as most research has focused on motivators and barriers. For example, how fair working conditions for nurses and doctors may require adjustments in the working environment. Further analysis can also be on the impact of these practices on the overall performance of the healthcare supply chain after implementation. This research may help healthcare actors implement sustainability practices without affecting the other side of their daily operations.

Another observation requiring further research is the extent of adoption of the reviewed practices. Given that this is an emerging field in the healthcare supply chain, future studies can examine to what extent economic, social, and environmental practices are adopted in healthcare supply chains. More studies are needed.

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