Contents lists available at GrowingScience

Uncertain Supply Chain Management

homepage: www.GrowingScience.com/uscm

# Enhancing supply chain performance of Saudi hospitals through resilience: The roles of supply chain integration and innovation

**Faouzi Ayadi**[a*]

[a]*Imam Mohammad Ibn Saud Islamic University, Saudi Arabia*

**A B S T R A C T**

This study aims at investigating the roles of supply chain integration and innovation on supply chain performance through a mediation mechanism of supply chain. This study develops a theoretical framework based on resource-based view and dynamic capability theory. Based on a quantitative study of 214 Saudi hospitals, an empirical analysis was made using a structural equation modelling with AMOS. Results revealed that supply chain integration and innovation positively affect supply chain resilience and performance. In addition, supply chain resilience has a positive and significant relationship with supply chain performance. Most significantly, the relationships of supply chain integration and of innovation to supply chain performance were found to be partially mediated by supply chain resilience. These results showed that integration and innovation have direct effects to improve supply chain performance and indirect ones when hospitals make efforts in developing their resilience. This study is important for top managers of Saudi hospitals to integrate their supply chains and innovate them to improve their resilience and performance.

*Article history*:
Received January 9, 2024
Received in revised format February 18, 2024
Accepted April 22 2024
Available online April 22 2024

*Keywords*:
*Supply Chain Management*
*Supply Chain Integration and Innovation*
*Supply Chain Resilience*
*Hospital Supply Chain Performance*
*Saudi Arabian Hospitals*



## 1. Introduction

The efficiency and effectiveness of hospital supply chains (HSC) have become crucial factors in determining the sustainability of healthcare systems and the quality of patient care in today's dynamic healthcare environment (Setiawati et al., 2023). HSC remains a complex network of activities and processes involved in the procurement, storage, distribution, and management of medical supplies, pharmaceuticals, and equipment within healthcare facilities (Arji et al., 2023). These HSC play a critical role in ensuring the availability of essential resources for patient care (Kumar et al., 2023). Sharing information and coordinating critical operations and flows between key partners become critical for improving the performance of the supply chain (SC) (Aldrighetti et al., 2019). However, in a turbulent environment, HSC can be disrupted in their operations due to unexpected events and unprecedented times (wars, sanitary crises such as COVID-19 pandemic). Hospitals need to take measures to mitigate the risks caused by these disruption events (Castillo, 2023; Ozdemir et al., 2022; Singh and Parida, 2022; Spieske et al., 2022). They must take innovative measures in their SC based on new technologies and artificial intelligence (new ways of sharing information and coordinating operations among partners) (Kraus et al., 2021; Kumar et al., 2023). Such integration and innovation in the SC play as enablers to build hospital supply chain resilience (HSCRes) capability, which in return improve the Hospital Supply Chain Performance (HSCPerf) (Junaid et al., 2023).

In Saudi Arabia, the healthcare sector is getting more fascinating among researchers and practitioners because of its important role played in the Saudi society to achieve the Saudi Vision 2030 (Al-Kahtani et al., 2022; Ayadi, 2022). This is the case for Saudi hospitals that provide healthcare services and facilities for all citizens and residents. Their efficiency is deemed to be critical, and the reduction of their supply costs becomes imperative (Alshahrani et al., 2018). During the COVID-10 pandemic, the SC of hospitals was found to be disrupted. The scarcity of critical medical supplies during the COVID-19 pandemic led to significant procurement challenges in healthcare supply chains. The discourse surrounding enhancing supply chain

* Corresponding author
E-mail address fmayadi@imamu.edu.sa (F. Ayadi)

ISSN 2291-6830 (Online) - ISSN 2291-6822 (Print)

doi: 10.5267/j.uscm.2024.4.017

resilience in healthcare has gained momentum, as ensuring the availability of these items during disruptions is crucial (Spieske et al., 2022). For instance, Supply Chain Resilience (SCRes) becomes very critical for healthcare and especially for hospitals. Little literature has investigated the simultaneous roles of Supply Chain Integration (SCInteg) and innovation (SCInnov) on SCRes and SCPerf in the hospital sector in Saudi Arabia.

To address this research gap, there is a focus on understanding the factors that determine HSCPerf and the internal mechanism (resilience) that influences the relationship between hospital supply chain integration (HSCInteg), innovation, and HSCPerf. It is argued that research should explore how HSCRes plays a role in the relationship between HSCInteg, innovation, and HSCPerf. This research stream is still underdeveloped within disruptive contexts in emerging countries (Benzidia et al., 2023; Dubey et al., 2021; Kumar et al., 2023).

This research explores the impact of integrating and innovating HSC on HSCPerf, specifically examining how HSCRes acts as a mediator. By leveraging the dynamic capability view (DCV) in the hospital context, we aim to understand the mechanisms and outcomes of HSCInteg and HSCInnov. Based on selected literature, the adoption of the DCV framework allows us to establish a solid theoretical foundation for our research, particularly considering the significance of resilience as a dynamic capability (DC) enabling hospitals to adapt to external environmental changes (Bahrami et al., 2022; Belhadi et al., 2021; Schilke et al., 2018).

The paper is structured as follows: Section 2 introduces the theoretical background by presenting the core concepts of HSCInteg, HSCInnov, HSCRes, and HSCPerf, viewed through the lenses of Resource Based View (RBV) and DC. It further delineates the proposed model and outlines the hypotheses. Section 3 elucidates the methodology employed in this study, along with the data analysis approach. In Section 4, the study's findings are presented, and Section 5 discusses these findings, along with theoretical and managerial implications. The paper wraps up in its concluding section, summarizing the key findings, noting limitations, and proposing avenues for future research.

## 2. Literature review and hypotheses development

### *2.1. Theoretical background*

#### *2.1.1. Dynamic capability perspective*

In this study, we consider the dynamic capability perspective which is grounded in the review-based view as the appropriate theoretical framework for justifying how HSCPerf can be achieved through the possession of various resources and organizational capabilities (ordinary and dynamic) in volatile markets and highly dynamic, changing environments (Wamba et al., 2020). For instance, according to the DCV, supply chain integration and innovation are seen as foundational capabilities that lay the groundwork for developing higher-order capabilities like supply chain resilience and performance (Belhadi et al., 2021; Wamba et al., 2020). Building on the RBV, several scholars view supply chain integration and innovation as organizational resources that are valuable, rare, inimitable, and non-substitutable (Wong & Ngai, 2019; Bahrami et al., 2022). Drawing from the DC theory (Teece et al., 1997), supply chain resilience can be considered a DC, embodying absorptive, response, and recovery capabilities (Zhao et al., 2023). Consequently, supply chain resilience is perceived as an organizational capability enabling firms to identify opportunities, solve problems, and mitigate risks and threats to maintain competitiveness and performance in their markets (Sabahi & Parast, 2020).

In the context of volatile and turbulent business environments, the application of the DC theory provides a relevant theoretical framework for examining the interplay between SCInteg and SCInnov in relation to bolstering firm resilience and optimizing organizational performance (Junaid et al. 2023; Belhadi et al., 2021). While there is an abundance of literature dealing with the SCRes concept and performance linkages, still very little studies have established a linkage between organizational supply chain resources, innovation and resilience capabilities and performance (Aloulou, 2023; Deng and Noorliza, 2023; Sabahi and Parast, 2020). The empirical investigation of supply chain integration, innovation and resilience from a dynamic capability perspective remains to be addressed in the literature and in the context of an emerging country. Identifying the organizational processes, integrating, and reconfiguring resource base purposefully, and the path through DC to follow by building resilience to attain competitive advantage and enhance performance (Chowdhury & Quaddus, 2017; Teece et al., 1997). Based on RBV and DC theory, this paper aims to discover simultaneously the influences of SCInteg and SCInnov on resilience and performance in the supply chain of hospitals. It investigates the internal mechanism that helps transform the way of integrating and innovating the hospital supply chain with the key partners into performance.

#### *2.1.2. Hospital Supply Chain Resilience*

The concept of resilience initially emerged in the literature within the field of engineering, its delineated and applied across various fields and disciplines in the literature (Dubey et al., 2021; Negri et al., 2021; Shishodia et al., 2023), universally shares a common conceptual foundation. Its definition across these domains revolves around the idea that resilience refers to the ability of a system to effectively manage and navigate changes or disruptions (e.g., war, sanitary crisis, etc.), allowing it to either revert to its original state or adapt to new circumstances (Castillo, 2023; Siagian et al., 2021). Changes, problems, and environmental disruptions at the industrial, ecological, healthcare levels, etc. have had a catastrophic effect on supply chains, especially when their networks are closely linked and interdependent, which makes them vulnerable and subject to several

risks (Dubey et al., 2021; Zhao et al., 2023). For instance, SCRes should include the ability to adapt to disturbances and the ability to manage risks.

Regarding the definition of the concept, several studies argued to consider that SCRes is a multidimensional construct encompassing different dimensions: absorptive capability, response capability, recovery capability (Zhao et al., 2023); or agility, adaptability, flexibility (Alkhatib & Momani, 2023); anticipation, monitoring, and response (Furstenau et al., 2022); anticipation, resistance, and recovery and response (Bahrami et al., 2022); flexibility, velocity, visibility, and collaboration (Rahman et al., 2023). SCRes is widely recognized as a fundamental capability within supply chains, enabling organizations to navigate disruptive events effectively (Akbar & Isfianadewi, 2023; Belhadi et al., 2021). This capability plays a crucial role in reducing vulnerability and risks and assisting companies in managing disruptions, facilitating a return to their previous operational state or even an improved one and avoid failure (Akbar & Isfianadewi, 2023; Alkhatib & Momani, 2023; Zhao et al., 2023). This capability is highly effective for addressing inevitable disruptions and a way of anticipating when risks are likely to occur (Senna et al., 2023b). According to Belhadi et al. (2021) and Ozdemir et al. (2022), The concept of SCRes encompasses the overarching focus on a supply chain's capacity to effectively manage and recover from immediate disruptive events, thereby reinstating or surpassing its prior performance level. This capability empowers organizations, such as hospitals, to maintain uninterrupted provision of their products and services to their customers (patients). In the same vein, Mandal (2017) argues that resilience holds greater significance in healthcare services as compared to other industries. This is primarily due to the criticality of delivering timely treatment and associated services to patients, as any failure in doing so can have fatal consequences.

The SCRes encompasses three dimensions: absorptive capability, response capability, and recovery capability. First, Absorptive capability involves utilizing redundant resources and proactive risk mitigation measures, including supply chain situational awareness, redundancy, and information visibility. Second, Response capability entails promptly adapting activities, resource allocation, and collaboration in the face of disruptions. SCRes aims to enhance a hospital supply chain's resilience in ensuring continuous product and service delivery to patients. Third, recovery capability pertains to a firm's capacity to swiftly restore itself to its original or an improved operational state by efficiently and cost-effectively addressing risk shocks during the later stages of their occurrence (Zhao et al., 2023).

*2.1.3. Hospital Supply Chain Integration*

The integration seen in supply chain management corresponds to improving and facilitating exchanges, connecting, and collaborating between different members of the supply chain on inter- and intra organizational processes (suppliers, manufacturers, customers…), allowing more efficient decision-making, and improving the visibility of supply chain activities, thereby anticipating blockages (Kim & Chai, 2016; Siagian et al., 2021). The concept of HSCInteg is fundamental for building resilience, flexibility, responsiveness, and a critical characteristic of resilient supply chains (Senna et al., 2023a; 2023b). After being integrated, hospitals must collaborate internally and externally for joint decision-making with stakeholders (from purchase, production, customer delivery). SCInteg entails the harmonization and cooperation among supply chain partners to promote effectiveness and efficiency in the seamless flow of materials, resources, and information. The objective is to produce valuable products and deliver services to customers swiftly and at a minimal cost (Afrifa et al., 2021; Flynn et al., 2010). In literature on supply chain management, SCInteg has been conceived differently as unidimensional (Senna et al., 2023a; 2023b), bidimensional construct with information sharing and operational coordination (Alsadi & Aloulou, 2021), or multidimensional construct with internal, supplier, and customer integrations (Dinh Khoa & Mai Anh, 2023; Flynn et al., 2010; Kim & Chai, 2016; Piprani et al., 2020; Seo et al., 2014). Healthcare Supply Chain Integration shares similarities with manufacturing firms in terms of its underlying basis and concept. In healthcare, achieving SCInteg involves expanding management boundaries both internally and externally by involving suppliers and customers. Internal integration facilitates the exchange of risk information among different departments within organizations, while external integration enables the seamless flow of information among supply chain partners, encouraging proactive response to disruptions through data and information sharing and coordinated operations (Adjei, 2022; Alsadi & Aloulou, 2021; Alshahrani et al., 2018; Senna et al., 2023a; 2023b).

In our study, HSCInteg is defined, according to Senna (2023b), as an hospital's capability to share information with key partners, coordinate operations and processes internally and externally, and seek strategic collaborative approaches with these partners. It refers to how all these activities are performed to help hospitals manage their supply chain flows, reduce potential adversity, and improve their resilience (Setiawan et al., 2023; Siagian et al., 2021).

*2.1.4. Hospital Supply Chain Innovation*

SCInnov involves improving outbound processes through technology and making changes that enhance effectiveness and customer satisfaction. It is considered a valuable and rare resource, leading to superior performance. SCInnov encompasses technological and process dimensions, focusing on integrated information systems, logistics equipment, real-time tracking, and service quality improvement and other technology based SCInnov (Jajja et al., 2020). Hospitals emphasize SCInnov which requires collaboration and information exchange among partners. Integrating innovative practices and systems in their business operations and processes can lead to efficient product, service provision and higher value creation for all stakeholders (Afraz et al., 2021; Bahrami et al., 2022; Bhatti et al., 2022; Kwak et al., 2018; Seo et al., 2014; Wong & Ngai, 2019). In a

dynamic business environment, hospitals can enhance their competitiveness by innovating within their supply chains, enabling them to offer novel and distinctive solutions to their patients (Afraz et al., 2021; Habidin et al., 2015; Morand, 2020). In the service sector, such as healthcare, SCInnov is recognized as a capability that pertains to a hospital's capacity to introduce new practices, tools, systems, and processes. The aim is to enhance the organizational processes required for effective supply chain management by fostering seamless interactions with stakeholders (Fernando et al., 2018; Lee et al., 2011).

*2.1.5. Hospital Supply Chain performance*

SCPerf in the hospital sector is critical for ensuring efficient and effective healthcare delivery. It encompasses factors such as timely availability of medical supplies, accurate inventory management, streamlined logistics, and effective coordination between stakeholders to respond quickly to volatile business environments (Bag et al., 2020). A well-performing supply chain is crucial for delivering quality patient care while minimising costs (effectiveness) and optimizing resource utilization (efficiency) (Senna et al., 2023a; 2023b). It is also about benefiting from the efficiency of the supply chain operations (Belhadi et al., 2021). In the hospital sector, SCPerf measures the efficacy and efficiency of activities aimed at meeting patient requirements, as well as the economic utilization of a firm's resources in delivering a predefined level of patient satisfaction. (Adjei, 2022). In the hospital sector, SCPerf evaluates the ability to meet customer requirements effectively and efficiently, while economically utilizing resources to deliver a specified level of patient satisfaction. It assesses the effectiveness of actions taken to meet patient needs and optimize resource utilization in line with patient expectations (Adjei, 2022). Accordingly, HSCPerf is measured in terms of resources used, outputs, and flexibility compared to rivals (Bahrami et al., 2022; Fernando et al., 2018).

*2.2. Hypotheses development*

*2.2.1. Hospital supply chain resilience and hospital supply chain performance*

It has been noted that SCRes is an essential element to improve business performance in general, especially its financial and competitive performance (Kwak et al., 2018). Literature on the relationship between SCRes and SCPerf is abundant in several industries and in the hospital sector (Bahrami et al., 2022; Junaid et al., 2023; Senna et al. 2023b; Zhao et al., 2023). Several studies argue that this relationship is positive and significant involving those that exist between resilience dimensions and performance. For example, Zhao et al., (2023) found that most of the resilience dimensions such as response and recovery are found to be significantly related to SCPerf while absorptive capability is not. SCPerf was measured in terms of operation cost, return on investment, lead time and customer satisfaction in the manufacturing industry. In the hospital sectors, SCRes can be developed to safeguard the supply chain from risks and expedite the restoration of their performance to pre-disruption levels (Junaid et al., 2023; Piprani et al., 2020; Senna et al., 2023a; Setiawan et al., 2023; Siagian et al., 2021).
Based on this, we suggest the following:

**$H_1$:** *There is a positive relationship between HSC resilience and HSC Performance.*

*2.2.2. Hospital supply chain integration and hospital supply chain performance*

SCInteg involves collaborating with Supply Chain partners to enhance operational efficiency through managing information flows and financial transactions (Piprani et al., 2020). It necessitates information sharing, action coordination and collaboration for competitive advantage (Junaid et al., 2023; Morand, 2020). The complete potential of SCInteg can be achieved by integrating processes, activities, and supply chain flow technologies with collaborative partners (Afrifa et al., 2021; Alsadi and Aloulou, 2021; Seo et al., 2014). Higher levels of SCInteg in hospitals have been shown to positively impact SCPerf by improving coordination, communication, and efficiency, leading to enhanced patient care, reduced costs, and better overall operational outcomes (Senna et al., 2023b; Alshahrani et al., 2018).
Based on this, we suggest the following:

**$H_2$:** *There is a positive relationship between HSC integration and HSC Performance.*

*2.2.3. Hospital supply chain innovation and hospital supply chain performance*

Previous research has consistently highlighted the significance of innovation in driving improvements and advancements in products, services, and processes, consequently enhancing overall organizational performance (Aloulou, 2023; Bhatti et al., 2022). In the service sectors, Fernando et al., (2018) found that SCInnov capabilities have positive relationships with SCPerf in terms of flexibility, responsiveness, reliability, and customer service. In the hospital sector, SCInnov plays a crucial role in improving overall performance. By embracing innovative and IT practices such as real-time tracking systems, automation, and data analytics, hospitals can streamline operations, optimize inventory management, reduce costs, and enhance patient outcomes (Bahrami et al., 2022; Benzidia et al., 2023; Ethirajan & Kandasamy, 2021; Kumar et al., 2023). SCInnov enables better coordination, information sharing, and decision-making, leading to improved patient satisfaction, reduced waiting times, increased operational and supply chain efficiency, and healthcare performance (Belhadi et al., 2021; Habidin et al., 2015; Lee et al., 2011; Yoon et al., 2016). Ultimately, SCInnov has a positive impact on various aspects of hospital performance, including the quality of care provided, the effective utilization of resources, and the long-term financial sustainability of the organization. Based on this, we suggest the following:

**H3:** *There is a positive relationship between HSC innovation and HSC Performance.*

*2.2.4. Hospital supply chain integration and hospital supply chain resilience*

The hospital sector is highly dependent on a well-functioning and resilient supply chain to ensure the availability of critical resources, such as medical supplies, pharmaceuticals, and equipment. SCInteg facilitates effective coordination and collaboration among various stakeholders, including suppliers, distributors, and healthcare providers. By integrating supply chain activities and information flows, hospitals can enhance their ability to anticipate, respond to, and recover from disruptions, such as supply shortages or emergencies (Piprani et al., 2020; Senna et al. 2023a). A resilient supply chain ensures the timely availability of essential resources, minimizes disruptions in patient care, and enables effective resource management, ultimately contributing to the overall resilience of hospitals in their sector (Junaid et al., 2023).
Based on this, we suggest the following:

**H4:** *There is a positive relationship between HSC Integration and HSC Resilience.*

*2.2.5. Hospital supply chain innovation and hospital supply chain resilience*

In general, the literature found that innovation capability is an enabler to firm resilience (Aloulou, 2023; Sabahi and Parast, 2020). In the supply chain literature, SCInnov involves the adoption of new technologies, processes, and strategies to enhance the efficiency, effectiveness, and responsiveness of the supply chain (Afraz et al., 2021). In the hospital sector, SCInnov plays a crucial role in building resilience. By embracing innovative practices like real-time tracking systems, predictive analytics, and automation, hospitals can improve supply chain visibility, optimize inventory management, and enhance demand forecasting (Arji et al., 2023; Belhadi et al., 2021; Furstenau et al., 2022; Kumar et al., 2023; Tortorella et al., 2022a, 2022b, 2022c). These innovations enable hospitals to respond swiftly to disruptions, adapt to changing circumstances, and ensure the availability of critical resources. SCInnov enhances the overall resilience of the hospital sector by enabling better resource allocation, minimizing delays, and improving patient care outcomes (Belhadi et al., 2021; Tortorella et al., 2022b, 2022c).
Based on this, we suggest the following:

**H5:** *There is a positive relationship between HSC Innovation and HSC Resilience*

*2.2.6. Mediation Role of Hospital supply chain resilience in the Hospital supply chain integration – hospital supply chain performance*

Literature on HSCInteg, HSCRes and HSCPerf showed that hospitals need to create synergistic efforts with their partners through the integration of their supply chains as enablers in doing so. However, in today's dynamic business environment, this can be done through a higher level of resilience to ensure higher (operational) performance (Deng and Noorliza, 2023; Piprani et al., 2020; Siagian et al., 2021). In fact, having such a resilience capability helps the hospital to prepare and respond to different disruptions. So, a mediating role of HSCRes is supposed to be played between HSCInteg and HSCPerf.
Based on this, we suggest the following:

**H6:** *HSC Resilience mediates the relationship between HSC integration and HSC Performance.*

*2.2.7. Mediation Role of Hospital supply chain resilience in the Hospital supply chain innovation – hospital supply chain performance*

Based on DC theory and in a turbulent and changing environment, hospitals must consider their SCInnov as an important capability to enable HSCRes against disruptive events. Using new ways to manage the supply chain, integrating and adopting new technologies (digital, AI, big data analytics…) can help hospitals to manage risks, be resilient and higher performers (Alsmairat, 2023; Bahrami et al., 2022; Junaid et al., 2023; Senna et al. 2023a). In their work, Afraz et al., (2021) found that SCRes mediates the relationship between SCInnov and competitive advantage for firms operating in the construction sector.
From above, we can state the following hypothesis:

**H7:** *HSC Resilience mediates the relationship between HSC innovation and HSC Performance*

## 3. Research Model

Fig. 1 illustrates the research model and hypotheses suggesting the influence of HSCInteg and HSCInnov on HSCPerf through HSCRes.

## 4. Methodology

To validate our research hypotheses, we adopted a field survey research approach and administered questionnaires to hospital supply chain executives and other top managers to gather data. The subsequent sections delve into the data collection process and the measures employed for this study.

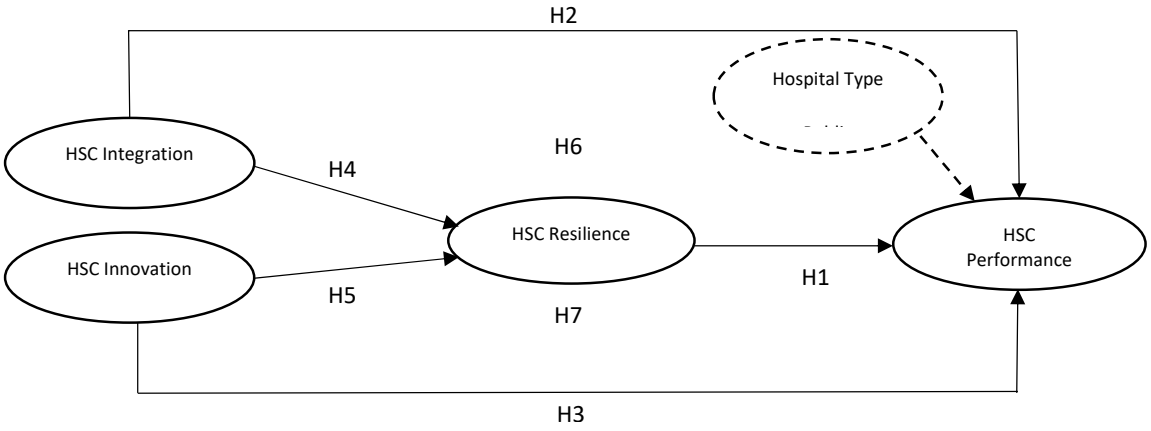


**Fig. 1.** The hypothesized research model

*4.1. Sampling and data collection*

Data collection for this study took place from April to September 2023, utilizing an online survey questionnaire administered through an online Google Form. The survey link was distributed via email, WhatsApp groups, and various social media platforms. Participants to this study were mainly members of management (middle and senior managers) of Saudi Hospitals. From a population of 425 public and private hospitals operating in Saudi Arabia (see Table 1), a total of 214 observations were thus collected with a response rate of 50.35%. This rate reflects the degree to which we succeed in obtaining the collaboration of all managers included in the sample. After screening and purification, employing techniques outlined in Tabachnick et al. (2013), no redundant or outlier observations were detected. As a result, all 214 observations were deemed suitable for analysis to test the research hypotheses.

**Table 1**
Population of Saudi hospitals and distribution by region

| Region | Number | Percentage |
|---|---|---|
| Central | 107 | 25.18% |
| Northern | 66 | 15.53% |
| Southern | 85 | 20.00% |
| Western | 108 | 25.41% |
| Eastern | 59 | 13.88% |
| Total | 425 | 100.00% |

Source: Hospitals Population in Saudi Arabia (https://od.data.gov.sa/Data/ar/dataset/total-number-of-beds-per-inpatient-facility) visited September 15, 2023.

**Table 2**
Hospital's characteristics (N=214)

| **Firm's Characteristics** | **Frequency** | **%** |
|---|---|---|
| Ownership | | |
| Public | 118 | 55.14% |
| Private | 96 | 44.86% |
| Age | | |
| Less than 5 years | 29 | 13.55% |
| 5- 15 years | 76 | 35.51% |
| More than 16 years | 109 | 50.94% |
| Localization | | |
| Central | 88 | 41.12% |
| Northern | 29 | 13.55% |
| Western | 46 | 21.50% |
| Eastern | 27 | 12.62% |
| Southern | 24 | 11.21% |

Source: Author' elaboration

Table 2 presents the hospital's characteristics. More than 55.14% are hospitals from the public sector while more than 44.86 % are from the private sector. In terms of age, 50.94% are hospitals older than 16 years. These hospitals are mostly located in the central area of Riyadh (41.12%), the Capital of Saudi Arabia. Regarding the characteristics of the respondents (Table 3), the majority of them are male (82.24%), older between 26-30 years old (26.64%), well educated (86.45% having a bachelor or higher degree) and having work experience of more than 5 years (71.5%).

**Table 3**
Respondent's Characteristics (N=214)

| Respondent's characteristics | | |
|---|---|---|
| Gender | | |
| Male | 176 | 82.24% |
| Female | 38 | 17.76% |
| Age | | |
| Less than 25 years | 39 | 18.22% |
| 26-30 | 57 | 26.64% |
| 31-35 | 48 | 22.43% |
| 36-40 | 40 | 18.69% |
| More than 40 years | 30 | 14.02% |
| Academic Qualification | | |
| Intermediate / High school diploma or less | 29 | 13.55% |
| Bachelor | 121 | 56.54% |
| Postgraduate | 64 | 29.91% |

| Respondent Position | | |
|---|---|---|
| CEO | 30 | 14.02% |
| GM | 59 | 27.57% |
| Procurement/SCM/Store… | 70 | 32.71% |
| Healthcare Organization Consultant | 16 | 7.48% |
| Other Member of the Board | 18 | 8.41% |
| Other | 21 | 9.81% |
| Work experience | | |
| Less than 5 years | 61 | 28.50% |
| Between 5 and 10 years | 56 | 26.17% |
| Between 10 and 15 years | 48 | 22.43% |
| Between 15 and 20 years | 26 | 12.15% |
| More than 20 years | 23 | 10.75% |

Source: Author' elaboration

### *4.2. Variables Measurement*

In this study, HSCInteg and HSCInnov are used as an independent variable, HSCRes as mediator, and HSCPerf as a dependent variable. All constructs used in this study were adapted from the literature and measured on a five-point Likert scale ranging from 1 ("*strongly disagree*") to 5 ("*strongly agree*"). The list of the constructs' items is shown in Table 3.

*Hospital Supply Chain Integration*

HSCInteg is measured using 9 items adapted from Senna et al., (2023b). Previous studies adopted similar items (Barroso et al., 2010; Cagliano et al., 2016; Chaudhuri et al., 2018; Iakovou et al., 2007; Koufteros et al., 2005; Soni & Jain, 2011; Tang, 2006). A sample item is listed here: "*I consider it a good practice to share information with the purchasing department (e.g. demand forecast, production plans, production progress and stock levels)*".

*Hospital Supply Chain Innovation*

HSCInnov is measured using 6 items adapted from Bhatti et al., (2022). Previous studies have validated this scale in different industries: construction industry in Pakistan (Afraz et al., 2021); and logistics intermediaries and manufacturing in South Korea (Kwak et al., 2018) as examples. A sample item is also listed here: "*We pursue a cutting-edge system that can integrate information*".

*Hospital Supply Chain Resilience*

HSCRes is measured using 9 items from Zhao et al. (2023). This variable encompasses three dimensions: absorptive capability, response capability and recovery capability. For the absorptive capability, a sample item is listed here: "*We can have redundant resources in place prior to the onset of disruptions*". For the response capability, a sample item is listed here: "*We are able to make the right risk management decisions at the time of disruptions*". And for recovery capability, a sample item is listed here: "*We are able to speedily and efficiently return to normal operations after being disrupted*".

*Hospital Supply Chain performance*

HSCPerf is measured using 8 items from Bag et al. (2020) that were adapted from Gunasekaran et al. (2017). A sample item is listed here: "*Our Healthcare organization has visibility of supply chain dynamics in the network*".

*Control variables*

Only one control variable concerned hospital type: public vs. private ownership. Past studies recommended considering this variable (e.g., Bjorvatn, 2018).

### *4.3. Strategy of Analysis*

To identify the latent factors of the measurement items, we employed SPSS software (version 21.0) to conduct an initial exploratory factor analysis (EFA). Subsequently, we utilized AMOS software (version 21.0) to perform a confirmatory factor analysis (CFA), which aimed to refine and empirically validate the measurement constructs within the specific context of our research. Afterwards, an explanatory analysis was conducted using the maximum likelihood estimation (MLE) method within the AMOS software. This approach was chosen in accordance with the recommendations of Hair et al. (2019) to test the research hypotheses. Structural equation modelling (SEM) was selected as the appropriate method to analyze both direct and indirect effects, enabling simultaneous estimation of all hypothesized relationships in the research model, as stated by Collier (2020). A sample consisting of 214 observations was deemed sufficient for employing SEM.

### *4.4. Factorial Analysis, Reliability and Validity*

Table 4 displays the reliability and validity of the constructs. The findings from the exploratory factor analysis reveal that the factor loadings are statistically significant and exceed the threshold of 0.709. Additionally, the Kaiser-Meyer-Olkin (KMO) index surpasses the acceptable value of 0.6, indicating satisfactory sampling adequacy for the analysis. The constructs exhibit high reliability, with Cronbach's Alphas exceeding 0.872 and Composite Reliability (CR) indexes exceeding 0.904. Additionally, the convergent validity is demonstrated as the Average Variance Extracted (AVE) for each construct exceeds 0.587. The findings from the exploratory factor analysis indicate that the measurement items align with their designated factors according to theory. Furthermore, the confirmatory factor analysis reveals that the measures are unidimensional, reliable, and possess both convergent and discriminant validity.

**Table 4**

Convergent validity and reliability (Exploratory factorial analysis, reliability, and validity)

| Construct | # Items | Factor loading | % Variance | KMO | Cronbach's Alpha | CR | AVE |
|---|---|---|---|---|---|---|---|
| Independent variable | | | | | | | |
| Hospital Supply Chain Integration (HSCInteg) | HSCInteg1: I consider it a good practice to share information with the purchasing department (e.g. demand forecast, production plans, production progress and stock levels) | 0.755 | 58.695% | 0.934 | 0.911 | 0.927 | 0.587 |
| | HSCInteg2: I believe there should be information sharing with key suppliers (e.g. on sales forecast, production plans, order tracking, delivery status and stock levels) | 0.760 | | | | | |
| | HSCInteg3: I believe organisations should develop collaborative approaches with key suppliers (e.g. supplier development, risk/revenue sharing, long term agreements etc.) | 0.815 | | | | | |
| | HSCInteg4: I believe there should be joint decisions with key suppliers (e.g. on products, processes, quality improvement, cost control etc.) | 0.808 | | | | | |
| | HSCInteg5: I consider it essential that information systems are integrated with key suppliers (e.g. supplier-controlled inventory – VMI, Just-in-Time, Kanban, continuous replenishment) | 0.804 | | | | | |
| | HSCInteg6: I find it relevant to share information with key customers (e.g. sales forecast, production plans, order tracking, delivery status and stock levels) | 0.722 | | | | | |
| | HSCInteg7: There should be collaborative approaches with key customers (e.g. risk/revenue sharing, long-term agreements, etc.) | 0.719 | | | | | |
| | HSCInteg8: I consider it essential that information systems are integrated with key customers (e.g. supplier-controlled inventory – VMI, Just-in-Time, Kanban, continuous replenishment) | 0.761 | | | | | |
| | HSCInteg9: I consider it a good practice to make decisions together with the purchasing department (a good practice e.g. demand forecast, production plans, production progress and stock levels) | 0.743 | | | | | |
| Hospital Supply Chain Innovation (HSCInnov) | HSCInnov1: We pursue a cutting-edge system that can integrate information. | 0.794 | 61.058% | 0.872 | 0.872 | 0.904 | 0.611 |
| | HSCInnov2: We pursue technology for real-time tracking. | 0.806 | | | | | |
| | HSCInnov3: We pursue innovative vehicles, packages or other physical assets. | 0.771 | | | | | |
| | HSCInnov4: We pursue continuous innovation in core global supply chain processes. | 0.783 | | | | | |
| | HSCInnov5: We pursue agile and responsive processes against changes. | 0.780 | | | | | |
| | HSCInnov6: We pursue creative methods and/or services. | 0.752 | | | | | |
| Mediating variables | | | | | | | |
| Hospital Supply Chain Resilience (HSCRes) | Absorptive capability | | 60.567% | 0.911 | 0.918 | 0.932 | 0.606 |
| | SCRes1: We can have redundant resources in place prior to the onset of disruptions. | 0.709 | | | | | |
| | SCRes2: We can achieve a high level of data visibility. | 0.781 | | | | | |
| | SCRes3: We were able to maintain a high level of situational awareness and crisis prediction. | 0.800 | | | | | |
| | Response capability | | | | | | |
| | SCRes4: We are able to make the right risk management decisions at the time of disruptions. | 0.790 | | | | | |
| | SCRes5: We are able to provide a quick response to supply chain disruptions. | 0.811 | | | | | |
| | SCRes6: We are always able to maintain supply chain connectivity and collaboration at the time of Disruptions. | 0.780 | | | | | |
| | Recovery capability | | | | | | |
| | SCRes7: We are able to speedily and efficiently return to normal operations after being disrupted. | 0.742 | | | | | |
| | SCRes8: We were able to restructure resources and develop new supply chain continuity business plans after being disrupted. | 0.791 | | | | | |
| | SCRes9: We are able to extract useful knowledge from disruptions and achieve better supply chain operations after being disrupted. | 0.794 | | | | | |
| Dependent variable | | | | | | | |
| Hospital Supply Chain Performance (HSCPerf) | SCPerf1: Our Healthcare organization has visibility of supply chain dynamics in the network. | 0.798 | 61.181% | 0.929 | 0.908 | 0.926 | 0.612 |
| | SCPerf2: Risks in the supply network are managed proactively by our Healthcare organization. | 0.818 | | | | | |
| | SCPerf3: Our Healthcare organization has proper control on supply chain costs. | 0.793 | | | | | |
| | SCPerf4: Wastages in our supply chain network has been reduced significantly. | 0.721 | | | | | |
| | SCPerf5: Our Healthcare organization's primary supply chain has the ability to supply final customers with timely complete orders/services. | 0.813 | | | | | |
| | SCPerf6: Our Healthcare organization has the ability to adhere to environmental standards as per customer requirement. | 0.796 | | | | | |
| | SCPerf7: Our Healthcare organization has minimized buffer stocks at all levels throughout the supply chain. | 0.748 | | | | | |
| | SCPerf8: Our Healthcare organization's supply chain has the ability to respond faster than competitors in volatile business environment. | 0.764 | | | | | |

Note: Extraction method: principal component analysis/rotation method; Varimax with Kaiser normalisation.

Source: Author' elaboration

### *4.5. Correlation Matrix and Discriminant Validity*

Table 5 displays the descriptive statistics (average values, standard deviations), and the correlation coefficients of all studied variables. From this table, the correlation analysis yielded significant and high correlations among the constructs examined in the study. All correlations between variables were found to be statistically significant at a 2-tailed significance level of 0.01. Therefore, Table 5 also provides evidence of discriminant validity. Specifically, in line with the recommendations of Fornell and Larcker (1981), it is observed that the square root of the Average Variance Extracted (AVE) for each construct is higher than the correlation between that construct and all other constructs in the model.

**Table 5**
Correlation matrix, discriminant validity

| | Mean | S.D. | HSCInteg | HSCInnov | HSCRes | HSCPerf | HType |
|---|---|---|---|---|---|---|---|
| HSCInteg | *3.563* | *0.856* | *0.766* | | | | |
| HSCInnov | 3.601 | 0.804 | 0.756** | *0.782* | | | |
| HSCRes | 3.581 | 0.823 | 0.747** | 0.729** | *0.778* | | |
| HSCPerf | 3.565 | 0.834 | 0.712** | 0.712** | 0.704** | *0.782* | |
| HType | 1.45 | 0.499 | 0.059 | 0.035 | 0.037 | 0.034 | - |

Notes: S.D. = standard deviation;
** correlation is significant at the 0.01 level (2-tailed); * correlation is significant at the 0.05 level (2-tailed);
Diagonal elements (*Italic*) are the square root of the AVE. Off-diagonal elements are correlations between constructs.

### *4.6. Common Method Variance bias*

Since our study relied on self-reporting for all variables, there is a potential concern of common method bias. To address this issue of common method bias, we employed the approach recommended by MacKenzie and Podsakoff (2012) and conducted Harman's one-factor test on all variables. The analysis revealed the identification of four factors, with the largest factor explaining 48.922% of the total variance. As this value is below the threshold of 50%, it indicates that no single factor dominates the explanation of variance. Therefore, based on these findings, we can conclude that there is no substantial evidence of common method bias in our study.

### *4.7. Measurement Model and Model Fit*

To compare the fit of the multifactor model and the single overall latent factor model, a confirmatory factor analysis (CFA) was conducted, following the methodology outlined by Hair et al. (2019). The results revealed that the multifactor model provided a significantly better fit to the data [x2/DF = 1.464; IFI = 0.952; TLI = 0.946; CFI = 0.951; RMSEA = 0.047] compared to the one-factor model [x2/DF = 2.422; IFI = 0.848; TLI = 0.836; CFI = 0.847; RMSEA = 0.082]. These findings indicate that there is no substantial threat of common method bias present in the study.

## 5. Results

The previous statistics checks provided evidence for the research model hypotheses and a foundation for their tests of direct, indirect, and total effects on main variables of the model.

### *5.1. Direct Relationship Analysis*

A path analysis was performed to test the direct relationships among variables (Table 6). From Table 6, the hypothesis H1 stated that there is a positive relationship between HSCRes and HSCPerf was supported. In fact, there is a significant relationship between the two variables (S_Estimate = 0.361, $p < 0.01$).
Regarding hypothesis H2, the results revealed that there is a positive and significant relationship between HSCInteg and HSCPerf (S_Estimate = 0.312, $p < 0.01$). Thus, H2 also was supported.
For hypothesis H3 that states that there is a positive relationship between HSCInnov and HSCPerf is also supported, and this relationship is significant (S_Estimate = 0.261, $p < 0.05$).
Regarding H4 stating that there is a positive relationship between HSCInteg and HSCRes, results showed that H4 is supported, and a significant relationship was found between the two variables (S_Estimate = 0.442, $p < 0.001$).
Considering H5 stating that there is a positive relationship between HSCInnov and HSCRes, the findings showed that such a relationship is found to be significant (S_Estimate = 0.463, $p < 0.001$).

**Table 6**
Path analysis

| Relationship | | | Estimate | S_Estimate | S.E. | C.R. | P | Hypothesis |
|---|---|---|---|---|---|---|---|---|
| HSCPerf | ← | HSCRes | .410 | .361** | .128 | 3.217 | .001 | H1 supported |
| HSCPerf | ← | HSCInteg | .300 | .312** | .103 | 2.914 | .004 | H2 supported |
| HSCPerf | ← | SCInnov | .273 | .261* | .115 | 2.379 | .017 | H3 supported |
| HSCRes | ← | HSCInteg | .375 | .442*** | .089 | 4.197 | *** | H4 supported |
| HSCRes | ← | HSCInnov | .426 | .463*** | .097 | 4.370 | *** | H5 supported |
| HSCPerf | ← | HType | -.005 | -.003 | .065 | -.072 | .942 | - |

Notation: * significant at $p < 0.05$; ** significant at $p < 0.01$; *** significant at $p < 0.001$.
Model fit: x2/DF = 1.419; IFI = 0.953; TLI = 0.948; CFI = 0.953; RMSEA= 0.044.

*5.2. Mediation Analysis*

In this study, the research model includes one mediating variable: HSCRes (Hospital Supply Chain Resilience). To test the mediation hypotheses, we followed the procedure outlined by Baron and Kenny (1986), which was updated by Zhao et al. (2010) and Collier (2020). As recommended by Collier (2020), it is essential for all variables included in the mediation to exhibit correlations with each other. Therefore, we employed the bootstrapping technique to observe the indirect effects of HSCInteg (Hospital Supply Chain Integration) and HSCInnov (Hospital Supply Chain Innovation) on HSCPerf (Hospital Supply Chain Performance) through the mediating variable HSCRes (Hospital Supply Chain Resilience). Subsequently, we conducted a mediation model analysis using structural equation modeling (SEM), and the corresponding results are presented in Table 6.

From Table 7, the study findings revealed that HSCRes mediates the relationship between HSCInteg and HSCPerf and between HSCInnov and HSCPerf. Hypotheses H6 and H7 are supported. In fact, we followed the recommendations of Baron and Kenny (1986), Collier (2020) and Zhao et al. (2010) and we found that HSCInteg and HSCInnov have direct and indirect effects on HSCPerf through HSCRes. In short, HSCRes partially mediates these two relationships.

**Table 7**
Mediation analysis

| Hypothesis | From IV | Mediation | To DV | Direct Effect | Indirect Effect | Total Effect | Mediation Test |
|---|---|---|---|---|---|---|---|
| H6 | HSCInteg | HSCRes | HSCPerf | 0.312** | 0.160* | 0.472* | Partial mediation |
| H7 | HSCInnov | HSCRes | HSCPerf | 0.261* | 0.167* | 0.428** | Partial mediation |

Notation: * $p < 0.05$; ** $p < 0.01$.

A bootstrapping technique was carried out with 200 bootstrap samples and 95 bias corrected confidence intervals.

Fig. 2 shows the significant and nonsignificant paths between the main variables of the final model.

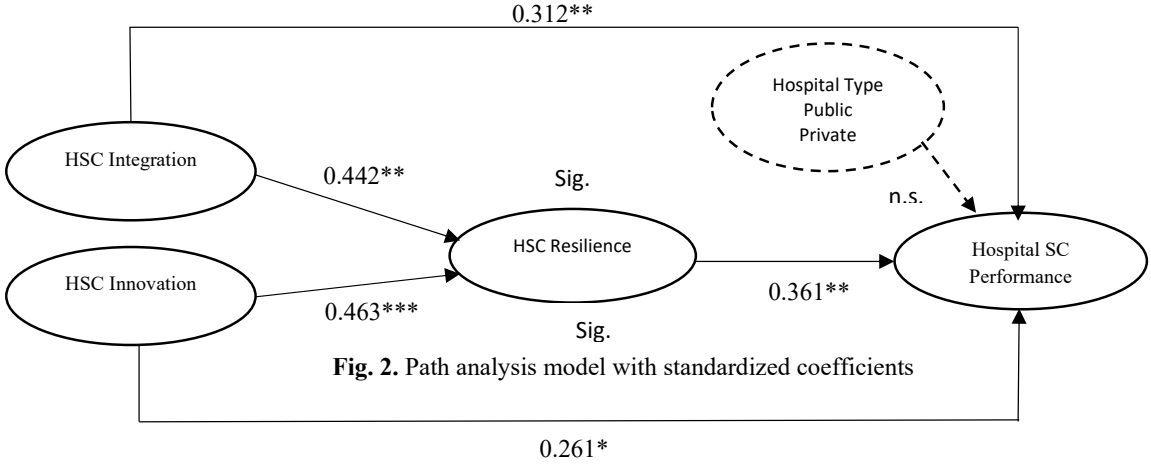


**Fig. 2.** Path analysis model with standardized coefficients

## 6. Discussion, Implications, and future research

*6.1. Discussion*

The primary objective of this study was to investigate the mechanism by which HSCInteg and innovation influence HSCPerf through the mediating role of HSCRes within the context of Saudi Arabia. Drawing upon the RBV and DC theory, a conceptual framework was established to examine and assess the relationships among the main variables, including the independent variables (HSCInteg and HSCInnov), the mediator variable (HSCRes), and the dependent variable (HSCPerf). The research hypotheses were developed, tested, and analyzed accordingly. At the empirical level, the study results revealed that there is a positive relationship between HSCRes and HSCPerf. Such finding is consistent with previous studies (Piprani et al., 2020; Bahrami et al., 2022; Chowdhury & Quaddus, 2017). In their study conducted in Pakistan and based on data from 182 manufacturing firms, Piprani et al., (2020) found SCRes substantially impacted SCPerf. Therefore, Bahrami et al., (2022) found similar results when investigating the relationship in manufacturing sectors in Iran. The study results also showed that there is a positive relationship between HSCInteg and HSCPerf. This result is in line with previous studies linking the two variables (Alshahrani et al., 2018; Senna et al., 2023b; Setiawan et al., 2023). In their study, Senna et al., (2023b) argued that SCInteg influences the SCPerf in both 214 public and private healthcare professionals. In Saudi context, Alshahrani et al., (2018) found similar results regarding the impact of hospital-supplier integration on SCPerf. Regarding the relationship between HSCInnov and HSCPerf, the study findings showed that a positive and significant relationship exists between the two variables. This result is in line with previous studies (Bahrami et al., 2022; Belhadi et al., 2021; Kumar et al., 2023; Lee et al., 2011). This result highlights the importance of SCInnov in terms of technology innovations in enhancing the SCPerf as

found in Bahrami et al., (2022) or Kumar et al., (2023). Accordingly, Lee et al., (2011) found that SCInnov has a significant impact on SCPerf of 243 large hospitals in South Korea.

Similarly, the findings of the study showed that there is a positive relationship between HSCInteg and HSCRes. These findings confirmed previous studies (Piprani et al., 2020; Setiawan et al., 2023; Siagian et al., 2021). For example, Piprani et al., (2020) found that the SCInteg dimensions (internal, customer and supplier integrations) are significantly related to SCRes. The information sharing and operational coordination and collaboration between partners increase SCRes in response to changing environmental conditions. A higher SCInteg enables the supply chain to respond to disruptions (Setiawan et al., 2023; Siagian et al., 2021). Considering the hypothesis stating that there is a positive relationship between HSCInnov and HSCRes. The findings are confirmed by previous literature on the topic (Afraz et al., 2021; Belhadi et al., 2021; Siagian et al., 2021; Yoon et al., 2016). Innovating in the supply chain by adopting new technology (AI-based) for information sharing and collaboration becomes helpful to build resilience (Siagian et al., 2021; Yoon et al., 2016). For the mediation analysis, the study findings showed that HSCRes played a significant and partial mediating role in the relationships between HSCInteg and HSCPerf and between HSCInnov and HSCPerf. Previous studies confirmed such findings (Junaid et al., 2023; Piprani et al., 2020; Siagian et al., 2021). HSCInteg and HSCInnov have both direct and indirect effects on HSCPerf through HSCRes.

### *6.2. Implications*

#### *6.2.1. Theoretical implications*

The current study used the RBV and DC perspectives to build its theoretical robust framework linking integration and innovation to performance through resilience. This study contributes to the literature on supply chain management and healthcare in an emerging country. Previous research has shown support for the study findings for the direct relationships among main constructs. An abundant literature was found in the manufacturing sectors (Piprani et al., 2020; Siagian et al., 2021), but little research has investigated the mediating role of resilience on the integration and innovation of the supply chain in hospital sector (Lee et al., 2011; Senna et al., 2023b) and especially in Saudi Arabia (Alshahrani et al., 2018). It is satisfactory to consider integration and innovation as enablers for gaining resilience in the supply chain and enhancing its performance. Resilience is a must and prerequisite to improve SCPerf.

#### *6.2.2. Practical implications*

This study emphasizes the significance of SCRes as a crucial dynamic capability within the context of hospitals facing frequent disruptions in their supply chains. The findings of this study have practical implications, suggesting that top managers in Saudi public and private hospitals should prioritize enhancing SCInteg with their key partners to foster innovation in their supply chains and build resilience. By doing so, hospitals can improve their performance even in the face of disruptive conditions. Saudi Top managers of public and private hospitals should invest in new technologies to better integrate their supply chains for a better provision of adequate responses to disruptions and for maintaining higher performance.

### *6.3. Limitations and scope for future research*

This study acknowledges two main limitations. Firstly, the data collection was conducted exclusively in Saudi Arabia, which implies that the findings may primarily pertain to the specific context of this country and may not be directly applicable to other developing countries. Therefore, caution must be exercised when generalizing the results to other countries around the world, considering the unique conditions of Saudi Arabia. Secondly, the data collection solely relied on the perspectives of top managers within hospitals. While their insights are valuable, the exclusive reliance on top managers as the key informants may limit the comprehensiveness and diversity of perspectives within the study. Future research directions can potentially address the limitations of this study. First, future research should focus on gathering data from other sources. Second, future research direction is to conduct comparative analyses between public and private hospitals in Saudi Arabia. Third, future research should focus on how resilience is built over the time considering the integration and innovation in hospital supply chains. given the study’s cross-sectional character, a longitudinal study could assess the dynamics of resilience.

## 7. Conclusion

This study examined the impact of SCInteg and SCInnov on the SCPerf of Saudi hospitals, with the mediating role of SCRes. The findings provide support for the direct relationships between the main constructs, while partially supporting two hypotheses regarding the indirect effects of integration and innovation on performance through resilience. The results indicate that HSCInteg and HSCInnov have direct effects on both HSCRes and HSCPerf, while also indirectly influencing performance through resilience.

This research underscores the importance of HSCInteg and HSCInnov in developing and bolstering resilience to enhance business performance. Collaboration among all supply chain parties facilitates effective planning, production, delivery, and information sharing. Furthermore, each party should demonstrate a commitment to innovation by adopting new technologies and practices within their supply chains to enhance resilience and promptly respond to sudden supply and demand fluctuations.

**References**


Adjei, R. (2022). *Evaluation of Healthcare Supply Chain (HCSC) Resilience in Public Hospitals*, Doctoral dissertation, School of Business, Department of Supply Chain and Information Systems, Kwame Nkrumah University of Science and Technology, Kumasi.

Afraz, M. F., Bhatti, S. H., Ferraris, A., & Couturier, J. (2021). The impact of supply chain innovation on competitive advantage in the construction industry: Evidence from a moderated multi-mediation model. *Technological Forecasting and Social Change*, *162*, 120370. doi: 10.1016/j.techfore.2020.120370

Afrifa, S., Amoah, N., Fianko, S. K., & Dzogbewu, T. C. (2021). Supply chain integration and operational performance in health institutions: a structural model for mediation effects. *Polish Journal of Management Studies*, *24*(1), 9-27.

Akbar, H. M., & Isfianadewi, D. (2023). The role of supply chain resilience to relationships supply chain risk management culture and firm performance during disruption. *International Journal of Research in Business and Social Science (2147-4478)*, *12*(2), 643-652.

Al-Kahtani, N., Alrawiai, S., Al-Zahrani, B. M., Abumadini, R. A., Aljaffary, A., Hariri, B., Alissa, K., Alakrawi, Z., & Alumran, A. (2022). Digital health transformation in Saudi Arabia: A cross-sectional analysis using Healthcare Information and Management Systems Society' digital health indicators. *Digital Health, 8*, 20552076221117742.

Aldrighetti, R., Zennaro, I., Finco, S., & Battini, D. (2019). Healthcare supply chain simulation with disruption considerations: A case study from Northern Italy. *Global Journal of Flexible Systems Management*, *20*(Suppl 1), 81-102.

Alkhatib, S. F., & Momani, R. A. (2023). Supply Chain Resilience and Operational Performance: The Role of Digital Technologies in Jordanian Manufacturing Firms. *Administrative Sciences*, *13*(2), 40.

Aloulou, W. J. (2023). Be Innovative and Resilient: Empirical Evidence from Saudi Firms on How to Translate Entrepreneurial Orientation into Firm Performance. *Administrative Sciences*, *13*(7), 168.

Alsadi, A., & Aloulou, W.J., (2021). Impacts of strategic orientations on Saudi firm performance: is supply chain integration a missing link? *International Journal of Logistics Management*, *32*(4), 1264-1289. https://doi.org/10.1108/IJLM-02-2020-0080

Alshahrani, S., Rahman, S., & Chan, C. (2018). Hospital-supplier integration and hospital performance: evidence from Saudi Arabia. *The International Journal of Logistics Management*, *29*(1), 22-45.

Alsmairat, M. A. (2023). Big data analytics capabilities, SC innovation, customer readiness, and digital SC performance: the mediation role of SC resilience. *International Journal of Advanced Operations Management*, *15*(1), 82-97.

Arji, G., Ahmadi, H., Avazpoor, P., & Hemmat, M. (2023). Identifying resilience strategies for disruption management in the healthcare supply chain during COVID-19 by digital innovations: A systematic literature review. *Informatics in Medicine Unlocked*, 101199.

Ayadi, F. (2022). Critical Factors Affecting the Decision to Adopt Cloud Computing in Saudi Health Care Organizations. *The Electronic Journal of Information Systems in Developing Countries*, *88*(6), 1-20, e12231, https://doi.org/10.1002/isd2.12231.

Bag, S., Wood, L. C., Xu, L., Dhamija, P., & Kayikci, Y. (2020). Big data analytics as an operational excellence approach to enhance sustainable supply chain performance. *Resources, Conservation and Recycling*, *153,* 104559.

Bahrami, M., Shokouhyar, S., & Seifian, A. (2022). Big data analytics capability and supply chain performance: the mediating roles of supply chain resilience and innovation. *Modern Supply Chain Research and Applications*, *4*(1), 62-84. https://doi.org/10.1108/MSCRA-11-2021-0021.

Baron, R. M., & Kenny, D. A. (1986). The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of personality and social psychology*, *51*(6), 1173.

Barroso, A. P., Machado, V. H., Barros, A. R., & Machado, V. C. (2010, December). Toward a resilient supply chain with supply disturbances. In *2010 IEEE International Conference on Industrial Engineering and Engineering Management* (pp. 245-249). IEEE.

Belhadi, A., Mani, V., Kamble, S. S., Khan, S. A. R., & Verma, S. (2024). Artificial intelligence-driven innovation for enhancing supply chain resilience and performance under the effect of supply chain dynamism: an empirical investigation. *Annals of Operations Research*, *333*(2), 627-652. https://doi.org/10.1007/s10479-021-03956-x

Benzidia, S., Bentahar, O., Husson, J., & Makaoui, N. (2024). Big data analytics capability in healthcare operations and supply chain management: the role of green process innovation. *Annals of Operations Research*, *333*(2), 1077-1101.

Bhatti, S. H., Ahmed, A., Ferraris, A., Hirwani Wan Hussain, W. M., & Wamba, S. F. (2022). Big data analytics capabilities and MSME innovation and performance: A double mediation model of digital platform and network capabilities. *Annals of Operations Research*, 1-24.

Bjorvatn, A. (2018). Private or public hospital ownership: Does it really matter?. *Social Science and Medicine*, *196*, 166-174.

Cagliano, A. C., Grimaldi, S., & Rafele, C. (2016). Paving the way for warehouse centralization in healthcare: A preliminary assessment approach. *American Journal of Applied Sciences*, *13*(5), 490-500.

Castillo, C. (2023). Is there a theory of supply chain resilience? A bibliometric analysis of the literature. *International Journal of Operations and Production Management*, *43*(1), 22-47.

Chaudhuri, A., Boer, H., & Taran, Y. (2018). Supply chain integration, risk management and manufacturing flexibility. *International Journal of Operations and Production Management*, *38*(3), 690-712.

Chowdhury, M. M. H., & Quaddus, M. (2017). Supply chain resilience: Conceptualization and scale development using dynamic capability theory. *International Journal of Production Economics*, *188*, 185-204.

Collier, J. (2020). *Applied structural equation modeling using AMOS: Basic to advanced techniques*. Routledge.

Deng, Q., & Noorliza, K. (2023). Integration, resilience, and innovation capability enhance LSPs' operational performance. *Sustainability*, *15*(2), 1019.

Dinh Khoa, V., & Mai Anh, N. T. (2023). Examining the Relationship Between Supply Chain Integration, Innovation Speed and Supply Chain Performance Under Demand Uncertainty. *Engineering Management Journal*, 1-16.

Dubey, R., Gunasekaran, A., Childe, S. J., Fosso Wamba, S., Roubaud, D., & Foropon, C. (2021). Empirical investigation of data analytics capability and organizational flexibility as complements to supply chain resilience. *International Journal of Production Research*, 59(1), 110-128.

Ethirajan, M., & Kandasamy, J. (2021). Need for embracing new digital technologies in healthcare supply chain. In *Managing Supply Chain Risk and Disruptions: Post COVID-19* (pp. 99-111). Cham: Springer International Publishing.

Fernando, Y., Chidambaram, R. R., & Wahyuni-TD, I. S. (2018). The impact of Big Data analytics and data security practices on service supply chain performance. *Benchmarking: An International Journal*, *25*(9), 4009-4034.

Flynn, B.B., Huo, B., & Zhao, X. (2010). The impact of supply chain integration on performance: a contingency and configuration approach. *Journal of Operations Management*, *28*(1), 58-71.

Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of marketing research*, *18*(1), 39-50.

Furstenau, L. B., Zani, C., Terra, S. X., Sott, M. K., Choo, K. K. R., & Saurin, T. A. (2022). Resilience capabilities of healthcare supply chain and supportive digital technologies. *Technology in Society*, *71*, 102095.

Gunasekaran, A., Papadopoulos, T., Dubey, R., Wamba, S. F., Childe, S. J., Hazen, B., & Akter, S. (2017). Big data and predictive analytics for supply chain and organizational performance. *Journal of Business Research*, *70,* 308-317.

Habidin, N. F., Shazali, N. A., Salleh, M. I., Zainol, Z., Hudin, N. S., & Mustaffa, W. S. W. (2015). A review of supply chain innovation and healthcare performance in healthcare industry. *International Journal of Pharmaceutical Sciences Review and Research*, *35*(1), 195-200.

Hair, J. F., Black, W. C., Babin, B. J., and Anderson, R. E. (2019). *Multivariate data analysis*. 8th edition, Hampshire, UK Cengage Learning, EMEA.

Iakovou, E., Vlachos, D., & Xanthopoulos, A. (2007). An analytical methodological framework for the optimal design of resilient supply chains. *International Journal of Logistics Economics and Globalisation*, *1*(1), 1-20.

Jajja, M.S.S., Asif, M., Shah, S.A.A., & Chatha, K.A. (2020). Supply chain innovation research: content analysis based review. *Benchmarking: An International Journal*, *27*(2), 666-694. https://doi.org/10.1108/BIJ-09-2018-0297

Junaid, M., Zhang, Q., Cao, M., & Luqman, A. (2023). Nexus between technology enabled supply chain dynamic capabilities, integration, resilience, and sustainable performance: An empirical examination of healthcare organizations. *Technological Forecasting and Social Change*, *196*, 122828.

Kim, M., & Chai, S. (2016). Assessing the impact of business uncertainty on supply chain integration. *The International Journal of Logistics Management*, *27*(2), 463–485, 2016.

Koufteros, X., Vonderembse, M., & Jayaram, J. (2005). Internal and external integration for product development: the contingency effects of uncertainty, equivocality, and platform strategy. *Decision sciences, 36*(1), 97-133.

Kraus, S., Schiavone, F., Pluzhnikova, A., & Invernizzi, A. C. (2021). Digital transformation in healthcare: Analyzing the current state-of-research. *Journal of Business Research*, *123*, 557-567.

Kumar, A., Mani, V., Jain, V., Gupta, H., & Venkatesh, V. G. (2023). Managing healthcare supply chain through artificial intelligence (AI): A study of critical success factors. *Computers and Industrial Engineering*, *175*, 108815.

Kwak, D. W., Seo, Y. J., & Mason, R. (2018). Investigating the relationship between supply chain innovation, risk management capabilities and competitive advantage in global supply chains. *International Journal of Operations and Production Management*, *38*(1), 2-21.

Lee, S. M., Lee, D., & Schniederjans, M. J. (2011). Supply chain innovation and organizational performance in the healthcare industry. *International Journal of Operations and Production Management*, *31*(11), 1193-1214.

MacKenzie, S. B., & Podsakoff, P. M. (2012). Common method bias in marketing: Causes, mechanisms, and procedural remedies. *Journal of retailing*, *88*(4), 542-555.

Mandal, S. (2017). The influence of organizational culture on healthcare supply chain resilience: moderating role of technology orientation. *Journal of business & industrial marketing*, *32*(8), 1021-1037.

Morand, M. (2020). *Hospital Supply Chain Integration and Its Impact on Outcomes*. Temple University ProQuest Dissertations Publishing, 2020. 27737773.

Negri, M., Cagno, E., Colicchia, C., & Sarkis, J. (2021). Integrating sustainability and resilience in the supply chain: A systematic literature review and a research agenda. *Business Strategy and the environment, 30*(7), 2858-2886.

Ozdemir, D., Sharma, M., Dhir, A., & Daim, T. (2022). Supply chain resilience during the COVID-19 pandemic. *Technology in Society*, *68*, 101847. doi: 10.1016/j.techsoc.2021.101847

Piprani, A. Z., Mohezar, S., & Jaafar, N. I. (2020). Supply chain integration and supply chain performance: The mediating role of supply chain resilience. *International Journal of Supply Chain Management*, *9*(3), 58-73.

Rahman, M. S., Gani, M. O., Fatema, B., & Takahashi, Y. (2023). B2B firms' Supply Chain Resilience Orientation in achieving Sustainable Supply Chain Performance. *Sustainable Manufacturing and Service Economics*, 100011.

Sabahi, S., & Parast, M. M. (2020). Firm innovation and supply chain resilience: a dynamic capability perspective. *International Journal of Logistics Research and Applications*, *23*(3), 254-269.

Schilke, O., Hu, S., & Helfat, C. E. (2018). Quo vadis, dynamic capabilities? A content-analytic review of the current state of knowledge and recommendations for future research. *Academy of management annals*, *12*(1), 390-439.

Senna, P., Reis, A., Dias, A., Coelho, O., Guimaraes, J., & Eliana, S. (2023a). Healthcare supply chain resilience framework: Antecedents, mediators, consequents. *Production Planning and Control*, *34*(3), 295-309.

Senna, P., Reis, A., Marujo, L. G., Ferro de Guimarães, J. C., Severo, E. A., & dos Santos, A. C. D. S. G. (2023b). The influence of supply chain risk management in healthcare supply chains performance. *Production Planning and Control*, 1-16.

Seo, Y. J., Dinwoodie, J., & Kwak, D. W. (2014). The impact of innovativeness on supply chain performance: is supply chain integration a missing link?. *Supply Chain Management: An International Journal*, *19*(5/6), 733-746.

Setiawan, H., Tarigan, Z., & Siagian, H. (2023). Digitalization and green supply chain integration to build supply chain resilience toward better firm competitive advantage. *Uncertain Supply Chain Management*, *11*(2), 683-696.

Setiawati, M., Pasaribu, A., Halim, D. P., & Darmawan, J. (2023). Exploring Hospital Supply Chain Partnership Factors and Its Impact on Overall Supply Chain Performance. *Petra International Journal of Business Studies*, *6*(2), 213-225.

Shishodia, A., Sharma, R., Rajesh, R., & Munim, Z. H. (2023). Supply chain resilience: A review, conceptual framework and future research. *The International Journal of Logistics Management*, *34*(4), 879-908.

Siagian, H., Tarigan, Z. J. H., & Jie, F. (2021). Supply chain integration enables resilience, flexibility, and innovation to improve business performance in COVID-19 era. *Sustainability*, *13*(9), 4669.

Singh, A., & Parida, R. (2022). Decision-making models for healthcare supply chain disruptions: review and insights for post-pandemic era. *International Journal of Global Business and Competitiveness*, *17*(2), 130-141.

Soni, U., & Jain, V. (2011, December). Minimizing the vulnerabilities of supply chain: A new framework for enhancing the resilience. In *2011 IEEE International Conference on Industrial Engineering and Engineering Management* (pp. 933-939). IEEE.

Spieske, A., Gebhardt, M., Kopyto, M., & Birkel, H. (2022). Improving resilience of the healthcare supply chain in a pandemic: Evidence from Europe during the COVID-19 crisis. *Journal of Purchasing and Supply Management*, *28*(5), 100748.

Tabachnick, B. G., Fidell, L. S., & Ullman, J. B. (2013). *Using multivariate statistics* (Vol. 6, pp. 497-516). Boston, MA: pearson.

Tang, C. S. (2006). Perspectives in supply chain risk management. *International journal of production economics*, *103*(2), 451-488.

Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal*, *18*(7), 509–533.

Tortorella, G. L., Fogliatto, F. S., Esposto, K. F., Mac Cawley Vergara, A., Vassolo, R., Tlapa Mendoza, D., & Narayanamurthy, G. (2022a). Measuring the effect of Healthcare 4.0 implementation on hospitals' performance. *Production Planning and Control*, *33*(4), 386-401.

Tortorella, G. L., Fogliatto, F. S., Saurin, T. A., Tonetto, L. M., & McFarlane, D. (2022b). Contributions of Healthcare 4.0 digital applications to the resilience of healthcare organizations during the COVID-19 outbreak. *Technovation*, *111,* 102379.

Tortorella, G., Prashar, A., Samson, D., Kurnia, S., Fogliatto, F. S., Capurro, D., & Antony, J. (2022c). Resilience development and digitalization of the healthcare supply chain: an exploratory study in emerging economies. *The International Journal of Logistics Management*, (ahead-of-print).

Wamba, S. F., Dubey, R., Gunasekaran, A., & Akter, S. (2020). The performance effects of big data analytics and supply chain ambidexterity: The moderating effect of environmental dynamism. *International Journal of Production Economics*, *222*, 107498.

Wong, D. T., & Ngai, E. W. (2019). Critical review of supply chain innovation research (1999–2016). *Industrial Marketing Management, 82*, 158-187.

Yoon, S. N., Lee, D., & Schniederjans, M. (2016). Effects of innovation leadership and supply chain innovation on supply chain efficiency: Focusing on hospital size. *Technological Forecasting and Social Change*, *113*, 412-421. https://doi.org/10.1016/j.techfore.2016.07.015

Zhao, N., Hong, J., & Lau, K. H. (2023). Impact of supply chain digitalization on supply chain resilience and performance: A multi-mediation model. *International Journal of Production Economics*, 108817. doi: https://doi.org/10.1016/j.ijpe.2023.108817

Zhao, X., Lynch, J. G., & Chen, Q. (2010). Reconsidering Baron and Kenny: Myths and truths about mediation analysis. *Journal of Consumer Research*, *37*(2), 197–206. https://doi.org/10.1086/651257.