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Supply Chain Risk Management on Health Outcomes: the Role of Information Technology Capability

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Abstract

Purpose: Most studies on supply chain risk management (SCRM) and health outcomes have focused on developed countries, leaving a gap in understanding how these dynamics play out in developing nations. This study seeks to address the gap by conducting the moderating effect of information technology capability on the relationship between supply chain risk management and health outcomes.

Methodology: The research adopts a positivist philosophy. The study employs an explanatory research design, which aims to determine the cause-and-effect relationships between the variables.. The population of the study comprises individuals and organizations directly involved in the supply chain and healthcare sectors. A stratified sampling technique is employed to ensure representation from various subgroups within the population, such as supply chain managers, IT specialists, and healthcare workers. Using a confidence level of 95% and a margin of error of 5%, the sample size is calculated to be 220 participants. The study utilizes primary data sources.

Findings: There is a strong and significant positive relationship between supply chain risk management and health outcomes. There is a significant and strong positive relationship between Information Technology Capability and Health outcomes. There is a positive and significant moderating role of Information technology capability in the relationship between supply chain risk management and health outcomes.

Unique contribution to theory, practice and policy: Healthcare organizations can leverage big data analytics, artificial intelligence (AI), and blockchain to proactively identify and mitigate supply chain risks, leading to better patient care and resource allocation. Governments and health regulators can use IT-powered risk management frameworks to enforce standardized protocols for healthcare logistics, improving equity and accessibility. The study recommends that healthcare organizations should prioritize investment in robust IT infrastructure to ensure their supply chains are equipped to handle dynamic risks effectively. Organizations should also integrate IT into their existing supply chain risk management frameworks. Health care organizations must prioritize the collection, analysis, and utilization of data to enhance decision-making in the supply chain.

Keywords: *Supply Chain Risk Management, Health Outcomes; Information Technology Capability*

1.1 Background of the Study

Supply chain risk management (SCRM) has gained significant attention in recent years as organizations strive to mitigate uncertainties that disrupt the flow of goods and services. The healthcare sector, in particular, is highly vulnerable to supply chain risks due to its dependency on timely and accurate delivery of medical supplies, equipment, and pharmaceuticals. Effective SCRM practices are critical in ensuring the availability of these essential resources, ultimately contributing to improved health outcomes (Kumar et al., 2021). Health outcomes, including patient safety, treatment efficiency, and overall public health, are profoundly affected by disruptions in the healthcare supply chain. Healthcare supply chains are increasingly complex and dynamic, involving multiple stakeholders, including suppliers, manufacturers, distributors, and healthcare providers. This complexity elevates the risk of inefficiencies, delays, and shortages. A recent global study highlighted that 80% of healthcare organizations experienced supply chain disruptions during the COVID-19 pandemic, emphasizing the urgent need for robust risk management strategies (Ivanov & Dolgui, 2021). Consequently, the adoption of SCRM practices, such as risk identification, assessment, mitigation, and monitoring, has become a priority to safeguard the resilience and reliability of healthcare supply chains.

Information technology (IT) capability is emerging as a crucial factor in enhancing the effectiveness of SCRM in the healthcare sector. IT capabilities enable real-time visibility, data analytics, and predictive modeling, which are instrumental in identifying potential risks and implementing proactive mitigation measures. For instance, advanced technologies such as blockchain and the Internet of Things (IoT) have been leveraged to improve traceability and transparency across supply chains (Chen et al., 2020). Moreover, digital platforms facilitate collaboration and information sharing among stakeholders, further strengthening the resilience of healthcare supply chains. The moderating role of IT capability in the relationship between SCRM and health outcomes has been widely acknowledged in academic and practical contexts. Studies indicate that organizations with higher IT capabilities are better equipped to respond to supply chain disruptions, ensuring continuity of care and minimizing adverse health impacts (Wamba et al., 2022). For example, predictive analytics powered by IT systems can forecast potential shortages of critical medical supplies, allowing healthcare providers to take preemptive actions. Despite the recognized importance of SCRM and IT capability, there is a scarcity of empirical studies that examine their combined impact on health outcomes, particularly in developing countries. Developing economies often face unique challenges, such as limited resources, inadequate infrastructure, and governance issues, which exacerbate supply chain vulnerabilities (Nyamah et al., 2023). Understanding how IT capability can enhance the effectiveness of SCRM in such contexts is essential for improving health outcomes and achieving sustainable healthcare delivery. This study aims to bridge the knowledge gap by exploring the impact of SCRM on health outcomes, with a particular focus on the moderating role of IT capability. By examining this relationship, the study seeks to provide valuable insights into how healthcare organizations can

leverage IT capabilities to mitigate supply chain risks and enhance health outcomes. The findings will have significant implications for policymakers, healthcare administrators, and supply chain practitioners striving to build resilient and efficient healthcare systems.

1.2 Problem Statement

Most studies on supply chain risk management (SCRM) and health outcomes have focused on developed countries, leaving a gap in understanding how these dynamics play out in developing nations. For instance, research specific to African countries, such as Ghana or Senegal, is sparse (Tang & Musa, 2021). Much of the existing literature examines SCRM in manufacturing or retail sectors, with limited studies addressing the healthcare supply chain specifically. This creates a need for more research on SCRM within healthcare to understand its unique challenges and impacts (Golan et al., 2020). There is a lack of consensus on the appropriate metrics for assessing health outcomes in the context of SCRM. Different studies use varying metrics, making it difficult to compare results and draw generalized conclusions (Hohenstein et al., 2015). Although information technology capability is recognized as a critical factor in enhancing supply chain performance, its role as a moderating variable in the relationship between SCRM and health outcomes is underexplored. Existing studies often treat IT capability as a direct influencer rather than a moderator (Gunasekaran et al., 2017). There is a need for more comprehensive theoretical models that integrate SCRM, IT capability, and health outcomes. Current models often overlook the interplay between these variables and do not adequately explain the mechanisms through which IT capability moderates the impact of SCRM on health outcomes (Tang & Musa, 2011).

SCRM research often lacks interdisciplinary approaches that combine insights from supply chain management, information systems, and public health. This gap limits the understanding of how integrated strategies can be developed to improve health outcomes (Golan et al., 2020). While it is known that IT capability can enhance SCRM, there is limited empirical evidence on how exactly it does so, particularly in healthcare settings. Studies are needed to identify the specific IT tools and capabilities that most effectively mitigate supply chain risks and improve health outcomes (Gunasekaran et al., 2017). Conducting studies in diverse geographic locations, particularly in developing countries, and focusing on the healthcare industry can provide a more comprehensive understanding of SCRM impacts. This can help tailor SCRM strategies to specific contexts and improve health outcomes globally (Golan et al., 2020). Researchers should work on developing and testing comprehensive theoretical models that integrate SCRM, IT capability, and health outcomes. This includes identifying and validating the mechanisms through which IT capability moderates the impact of SCRM on health outcomes (Gunasekaran et al., 2017). Promoting interdisciplinary research that combines supply chain management, information systems, and public health can lead to more holistic approaches to improving health outcomes through better SCRM practices. Collaborative efforts can yield innovative solutions that address multiple facets of the problem (Hohenstein et al., 2015). More empirical research is needed to identify the role of

IT in enhancing SCRM and improving health outcomes. This study seeks to address the gap by conducting the moderating effect of information technology capability on the relationship between supply chain risk management and health outcomes.

2. Literature Review

2.1 Supply Chain Risk Management

In today's volatile environment, as businesses and supply chains become increasingly globalized, the industrial landscape faces significant uncertainty, often leading to unexpected disruptions (McCormack etal., 2008). Addressing supply chain issues requires a multidisciplinary approach, intersecting with fields such as marketing, management, and economics. The broad scope of supply chains and the uncertainty across numerous parameters contribute to their complexity. Factors such as production and delivery timelines, quality, safety, inventory, transportation, and equipment reliability significantly influence supply chain performance. Pettit, Fiksel, and Croxton (2010) define risk as changes in potential output, the likelihood of their occurrence, and their magnitude. Risk management involves evaluating potential scenarios and weighing benefits against potential risks. According to Christopher and Peck (2004), supply chain risk management (SCRM) also refers to a system's ability to recover to its original or improved state following a disruption. While various definitions exist, they all converge on a common goal: safeguarding an organization's integrity against adverse events and their consequences to maximize operational resilience and profitability (Rowbottom, 2004; Van Hoek, 2003). The absence of effective risk management has led to significant losses for organizations; for example, Apple and Ericsson experienced losses of over €400 million and €300 million, respectively, due to inadequate risk management (Norrman & Jansson, 2004). SCRM typically follows a systematic process. Tuncel and Alpan (2010) outline four stages: risk identification, assessment, management, and monitoring. Similarly, Jüttner, Peck, and Christopher (2003) highlight four key aspects of SCRM: identifying risk sources in the supply chain, defining adverse outcomes, pinpointing risk drivers, and mitigating risks. Despite these frameworks, members of the Supply Chain Council report that fewer than half of organizations have established metrics and processes for assessing and managing supply risks. Many companies also lack adequate market intelligence, processes, and information systems to predict and address supply chain risks effectively. Fox, Barbuceanu, and Teigen (2001) argue that the next generation of supply chain management systems should be distributed, dynamic, intelligent, integrated, responsive, reactive, cooperative, interactive, always available, comprehensive, reconfigurable, generalizable, adaptable, and backward-compatible. However, Christopher et al. (2011) discovered that most companies lack a structured approach to managing and mitigating supply chain risks. Consequently, risks are often cited as the primary reason for underperformance in supply chains (Hendricks, Singhal & Zhang, 2009).

2.2 Contingency Theory

Contingency Theory emphasizes the importance of aligning organizational practices with external and internal conditions to achieve optimal performance (Donaldson, 2001). In the context of SCRM and health outcomes, IT capability serves as a contingency factor that influences the effectiveness of risk management strategies. Organizations with advanced IT capabilities can adapt more effectively to dynamic supply chain environments, ensuring continuity and reliability in healthcare delivery. A study by Prasad et al. (2021) highlighted how IT-enabled supply chain visibility allowed hospitals to respond swiftly to disruptions caused by natural disasters. Real-time data analytics and tracking systems facilitated the coordination of supply chain activities, minimizing the impact of disruptions on health outcomes. This aligns with the contingency perspective, which underscores the role of IT capability in enabling organizations to navigate complex and uncertain environments. Contingency Theory serves as a foundational framework for understanding how information technology (IT) capability moderates the relationship between supply chain risk management (SCRM) and health outcomes. The theory emphasizes that there is no one-size-fits-all approach to management; instead, organizational effectiveness depends on aligning strategies and practices with internal and external contingencies (Donaldson, 2001). In the context of SCRM and health outcomes, IT capability represents a critical contingency that enhances the efficacy of risk management strategies in dynamic healthcare environments. Contingency Theory suggests that organizational performance is influenced by the fit between environmental conditions and organizational practices. In healthcare supply chains, the ability to manage risks effectively depends on the integration of IT capabilities with SCRM practices. IT capability encompasses technical infrastructure, data analytics, and process automation, which enable healthcare organizations to respond to risks more effectively (Prasad et al., 2021). For example, during supply chain disruptions caused by natural disasters or pandemics, IT-enabled visibility and communication systems allow organizations to quickly identify bottlenecks and deploy mitigation strategies. This alignment of IT capability with SCRM practices ensures continuity in the delivery of healthcare services, thereby improving health outcomes.

The role of IT capability as a contingency factor lies in its ability to provide real-time data, enhance decision-making, and improve collaboration across supply chain stakeholders. According to Gunasekaran et al. (2019), IT-enabled supply chains are better equipped to manage risks because they facilitate proactive planning and rapid response to disruptions. This moderating effect is particularly critical in healthcare, where supply chain failures can have life-threatening consequences. For instance, a study by Lin et al. (2021) demonstrated that hospitals with advanced IT systems were able to maintain adequate stock levels of essential medical supplies during the COVID-19 pandemic. These hospitals leveraged predictive analytics and automated inventory management systems to mitigate supply chain risks, leading to better patient care and outcomes. Empirical research underscores the relevance of Contingency Theory in explaining the moderating effect of IT capability on SCRM and health outcomes. Prasad et al. (2021) found that healthcare

organizations with robust IT capabilities were more resilient to supply chain disruptions. These organizations exhibited higher levels of coordination, resource optimization, and risk mitigation, resulting in improved health outcomes. Another study by Oliveira et al. (2020) highlighted the role of IT in enabling supply chain visibility and traceability. The research showed that IT-enabled systems allowed healthcare providers to track the movement of critical supplies in real time, reducing the impact of risks on patient safety and treatment efficacy. This aligns with the Contingency Theory perspective, which emphasizes the importance of aligning IT capability with specific organizational needs and environmental conditions. Contingency Theory explains the moderating effect of IT capability by highlighting its ability to adapt risk management practices to varying levels of supply chain complexity and uncertainty. In highly dynamic environments, IT capability enhances organizational agility, allowing healthcare providers to respond swiftly to unforeseen disruptions (Donaldson, 2001). This adaptability is crucial for maintaining the flow of critical medical supplies and ensuring positive health outcomes. For example, research by Dubey et al. (2020) demonstrated that IT-enabled risk assessment tools improved the effectiveness of SCRM practices in healthcare organizations. These tools allowed for real-time risk identification and mitigation, reducing the likelihood of supply chain failures and improving patient outcomes. Contingency Theory provides a robust framework for understanding how IT capability moderates the relationship between SCRM and health outcomes. By aligning IT resources with organizational strategies and environmental conditions, healthcare organizations can enhance their resilience and effectiveness in managing supply chain risks. Empirical evidence supports the view that IT capability acts as a critical contingency factor, enabling healthcare providers to adapt to dynamic supply chain environments and deliver better health outcomes.

2.3 Impact of Supply Chain Risk Management on Health Outcomes

Supply chain risk management (SCRM) plays a pivotal role in ensuring the resilience and efficiency of healthcare systems, which directly impacts health outcomes. In the healthcare sector, risks such as disruptions in medical supply chains, inventory shortages, and logistical delays can jeopardize patient care and lead to adverse health outcomes (Dubey et al., 2020). Effective SCRM practices mitigate these risks by enhancing supply chain visibility, improving resource allocation, and ensuring timely delivery of critical medical supplies. A key aspect of SCRM is its ability to proactively identify potential risks and implement mitigation strategies. For example, real-time monitoring systems and predictive analytics enable healthcare providers to anticipate disruptions and take corrective actions before they affect patient care (Gunasekaran et al., 2019). By reducing uncertainties and ensuring the continuity of supply chains, SCRM contributes to improved treatment outcomes, patient satisfaction, and overall public health. Empirical evidence underscores the significance of SCRM in healthcare. Lin et al. (2021) demonstrated that hospitals with robust SCRM practices experienced fewer disruptions during the COVID-19 pandemic, ensuring the availability of essential supplies such as personal protective equipment and ventilators. This underscores the critical role of SCRM in maintaining the reliability of healthcare services and

safeguarding patient outcomes. Moreover, the integration of technology in SCRM amplifies its impact on health outcomes. Digital tools such as blockchain and IoT devices enhance supply chain transparency and accountability, reducing the likelihood of counterfeit or substandard medical products reaching patients (Prasad et al., 2021). These advancements strengthen the link between SCRM and positive health outcomes by fostering trust and reliability in healthcare supply chains. This Proposed that:

H1: Supply chain risk management positively influences health outcomes.

2.4 Impact of Information Technology Capability on Health Outcomes

Information technology (IT) capability is a critical enabler of enhanced health outcomes through its ability to streamline healthcare processes, improve decision-making, and enhance resource management. IT capability, which includes infrastructure, analytics, and digital tools, facilitates real-time data sharing, predictive modeling, and efficient communication across healthcare supply chains. This ensures the timely delivery of medical supplies and services, ultimately benefiting patient care (Prasad et al., 2021). One of the most significant impacts of IT capability is its role in improving supply chain visibility and traceability. Advanced IT systems, such as electronic health records (EHRs) and inventory management tools, enable healthcare providers to monitor inventory levels, predict demand, and prevent shortages (Gunasekaran et al., 2019). For instance, during the COVID-19 pandemic, hospitals with advanced IT infrastructure were better equipped to manage surges in demand for essential supplies like ventilators and personal protective equipment, thereby minimizing disruptions to patient care (Lin et al., 2021). Furthermore, IT capability enhances collaboration among stakeholders, including suppliers, healthcare providers, and government agencies. By fostering seamless communication and data integration, IT systems reduce inefficiencies and ensure that critical medical resources reach the right place at the right time (Dubey et al., 2020). This capability is particularly vital in rural and underserved areas, where healthcare facilities often face logistical challenges. Empirical studies corroborate the positive impact of IT capability on health outcomes. For example, Prasad et al. (2021) found that hospitals leveraging advanced IT systems reported higher patient satisfaction and better treatment outcomes due to improved resource availability and service efficiency. Similarly, Oliveira et al. (2020) highlighted the role of IT in enhancing supply chain resilience, leading to reduced patient mortality rates during supply chain disruptions. This Proposed that:

H2: Information technology capability positively influences health outcomes.

2.5 Moderating Effect of Information Technology Capability on Supply Chain Risk Management and Health Outcomes

Information technology (IT) capability serves as a powerful moderator in the relationship between supply chain risk management (SCRM) and health outcomes. By enhancing data visibility, predictive analytics, and real-time communication, IT capability enables healthcare systems to

manage supply chain risks more effectively, thereby improving health outcomes (Gunasekaran et al., 2019). SCRM involves identifying, assessing, and mitigating risks within the healthcare supply chain. While effective SCRM practices reduce disruptions, their efficacy is significantly amplified when integrated with robust IT capabilities. For instance, advanced IT systems provide real-time monitoring and data analytics, enabling healthcare providers to anticipate and respond swiftly to potential supply chain disruptions (Lin et al., 2021). This ensures the continuous availability of critical medical supplies, directly impacting patient care and treatment outcomes. The moderating role of IT capability is particularly evident in complex and uncertain environments. During the COVID-19 pandemic, organizations with superior IT infrastructure demonstrated a higher capacity to adapt to supply chain challenges, ensuring uninterrupted healthcare delivery (Dubey et al., 2020). IT tools such as blockchain, IoT devices, and cloud-based platforms enhanced supply chain transparency, reduced inefficiencies, and minimized risks of counterfeit products entering the system, leading to better health outcomes (Prasad et al., 2021). Moreover, IT capability facilitates better collaboration among supply chain stakeholders. By integrating communication channels and sharing real-time data, IT systems ensure that all parties in the supply chain can respond cohesively to risks, preventing delays and ensuring the timely delivery of medical resources (Oliveira et al., 2020). This collaborative efficiency underscores the critical role of IT capability in linking SCRM to improved health outcomes. This study Proposed that:

H3: Information technology capability positively moderates the relationship between supply chain risk management and health outcomes.

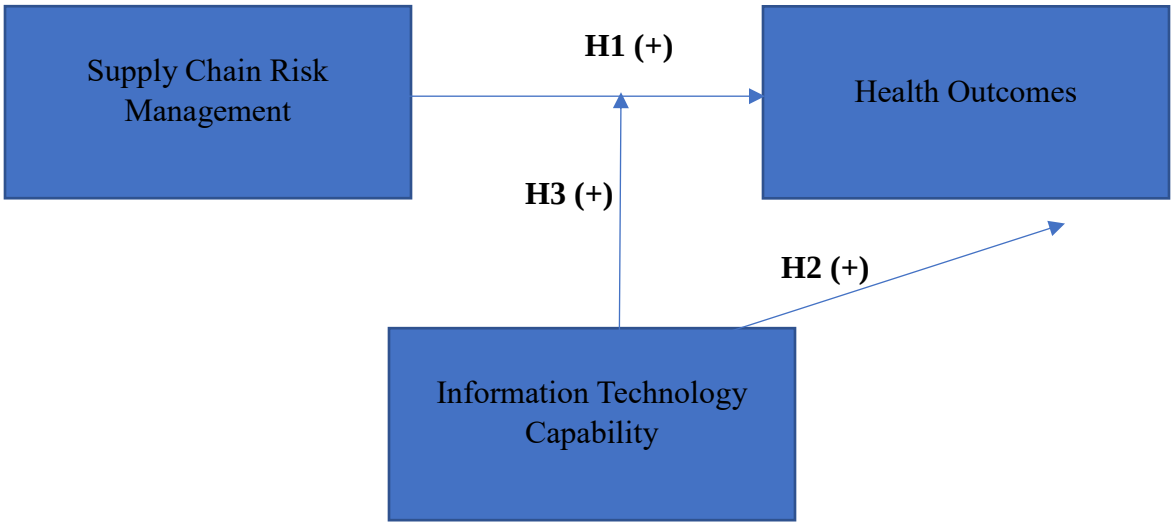

Figure 1 Conceptual Framework

3. Methodology

The study employs an explanatory research design, which aims to determine the cause-and-effect relationships between the variables (Blaxter et al., 2010). The research adopts a positivist philosophy, which is based on the assumption that reality can be observed and measured objectively. This perspective aligns with the study's quantitative approach. The population of the study comprises individuals and organizations directly involved in the supply chain and healthcare sectors. A stratified sampling technique was employed to ensure representation from various subgroups within the population, such as supply chain managers, IT specialists, and healthcare workers. Using a confidence level of 95% and a margin of error of 5%, the sample size is calculated to be 220 participants. The study utilizes primary data source. Primary data was collected directly from respondents through structured questionnaires.

4. Data Analysis and Results

4.1 Reliability and Validity

Reliability refers to the consistency or dependability of a measurement tool. Validity is the extent to which a measurement tool actually measures what it intends to measure. By employing statistical techniques such as Cronbach's Alpha for reliability and factor analysis for construct validity, the study provides assurance that the measurement instruments are both consistent and accurately measure the intended constructs. These efforts enhance the robustness of the study's findings and ensure that the conclusions drawn are based on sound, reliable data.

Table 4.1 KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.951
Bartlett's Test of Sphericity	Approx. Chi-Square	7954.503
	df	903
	Sig.	.000

Table 4.2 Reliability and Validity Results for Supply Chain Risk Management

Construct items	Factor loadings	Cronbach's Alpha	Composite Reliability (CR)	Convergent Validity (AVE)	Discriminant Validity (DV)
SCRM1	.660	.966	0.959	0.544	0.738
SCRM2	.698				
SCRM3	.728				
SCRM4	.667				
SCRM5	.840				
SCRM6	.812				
SCRM7	.744				
SCRM8	.736				
SCRM9	.658				
SCRM10	.797				
SCRM11	.832				
SCRM12	.815				
SCRM13	.695				
SCRM14	.684				
SCRM15	.754				
SCRM16	.635				
SCRM17	.718				
SCRM18	.789				
SCRM19	.690				
SCRM20	.750				

Table 4.3 Reliability and Validity Results for Health Outcomes

Construct items	Factor loadings	Cronbach's Alpha	Composite Reliability (CR)	Convergent Validity (AVE)	Discriminant Validity (DV)
HOC1	.726	.924	0.949	0.603	0.777
HOC2	.782				
HOC3	.824				
HOC4	.667				
HOC5	.835				
HOC6	.836				
HOC7	.752				

Table 4.4 Reliability and Validity Results for Information Technology Capability

Construct items	Factor loadings	Cronbach's Alpha	Composite Reliability (CR)	Convergent Validity (AVE)	Discriminant Validity (DV)
IT1	.722	.964	0.969	0.541	0.735
ITC2	.678				
ITC3	.794				
ITC4	.810				
ITC5	.815				
ITC6	.736				
ITC7	.769				
ITC8	.760				
ITC9	.745				
ITC10	.766				
ITC11	.776				
ITC12	.720				
ITC13	.801				
ITC14	.661				
ITC15	.618				
ITC16	.536				

The Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy and Bartlett's Test of Sphericity are critical tools in evaluating the suitability of data for factor analysis. The KMO value of 0.951 indicates an excellent level of sampling adequacy (Kaiser, 1974). A KMO value greater than 0.9 signifies that the variables in the dataset are highly intercorrelated and suitable for factor analysis. This result suggests that the dataset is robust and factor analysis will likely yield reliable dimensions. Bartlett's test examines whether the correlation matrix is significantly different from an identity matrix, which would suggest that factor analysis is inappropriate. The test yielded a Chi-Square value of 7954.503, degrees of freedom (df) of 903, and a significance level (Sig.) of 0.000. This result strongly rejects the null hypothesis, confirming that there are significant relationships among the variables and supporting the use of factor analysis (Hair et al., 2019). Supply Chain Risk Management (SCRM) Factor Loadings loadings range from 0.635 to 0.840, indicating that most items strongly correlate with their respective construct. Cronbach's Alpha: The alpha value of 0.966 exceeds the acceptable threshold of 0.7, demonstrating high internal consistency (Nunnally & Bernstein, 1994). Composite Reliability (CR): With a CR of 0.959, the construct demonstrates excellent reliability, showing that the measurement items consistently capture the underlying construct. Convergent Validity (AVE): The AVE of 0.544 exceeds the minimum threshold of 0.5, confirming that the items share a high proportion of variance in common. Discriminant Validity (DV): The DV value of 0.738 ensures that the SCRM construct is distinct from other constructs. Health Outcomes (HOC) Factor Loadings range from 0.667 to

0.836, signifying strong correlations between the items and the construct. Cronbach's Alpha: The alpha value of 0.924 indicates high reliability. Composite Reliability (CR): The CR of 0.949 confirms the consistency of the construct. Convergent Validity (AVE): The AVE of 0.603 surpasses the threshold, ensuring that the items explain a substantial proportion of the variance. Discriminant Validity (DV): The DV value of 0.777 confirms the distinctiveness of the construct. Information Technology Capability (ITC) Factor Loadings range from 0.536 to 0.810, reflecting adequate correlations, though a few items exhibit lower loadings (e.g., ITC16 at 0.536). Cronbach's Alpha: The alpha value of 0.964 signifies excellent reliability. Composite Reliability (CR): A CR value of 0.969 underscores the strong reliability of the measurement scale. Convergent Validity (AVE): The AVE of 0.541 meets the minimum criterion of 0.5, affirming that the items collectively measure the construct effectively. Discriminant Validity (DV): The DV value of 0.735 ensures that ITC is conceptually distinct from other constructs. The Cronbach's Alpha and CR values across all constructs confirm the internal consistency and dependability of the survey instrument. The high reliability indicates that the instrument is robust and can be used for further analysis with confidence. The AVE values validate that the survey items within each construct adequately explain their shared variance, ensuring the constructs' relevance and meaningfulness. The DV values demonstrate that the constructs are well-differentiated, reducing concerns of redundancy or overlap in the measurement model. The acceptable loadings across all constructs support the appropriateness of the items. The analysis confirms that the measurement model is statistically reliable and valid for further hypothesis testing and structural model evaluation. The robustness of the constructs enhances the credibility of the research findings and ensures that the instruments can accurately measure the intended constructs.

Table 4.5 Hypothesis Testing and Findings

Hypothesis	Relationship	Beta value	T value	P value	Remarks
H1	SCRM - -> HOT	.746	16.534	.000	Supported
H2	ITC - -> HOT	.861	24.998	.000	Supported
H3	SCRM*ITC - ->HOT	.1352	4.3142	.000	Supported

Positive effect of Supply Chain Risk Management on Health Outcomes

Supply Chain Risk Management (SCRM) positively influences health outcomes by ensuring the resilience and reliability of healthcare supply chains. Effective SCRM minimizes disruptions, enhances resource availability, and ensures the timely delivery of critical medical supplies, which directly impacts the quality of health services (Fan & Stevenson, 2018). By identifying and mitigating risks such as delays, shortages, and quality issues, organizations can maintain a consistent flow of essential resources, which improves patient care and health outcomes. Moreover, SCRM fosters collaboration among stakeholders, leading to better coordination and responsiveness in addressing emergencies or unforeseen disruptions (Gong et al., 2020). This is

particularly vital during crises, such as pandemics, where efficient risk management can save lives. SCRM practices, such as risk assessment, contingency planning, and supplier diversification, contribute to reducing vulnerabilities and enhancing the overall performance of healthcare systems (Ho et al., 2021). Empirical evidence further supports this positive relationship. For example, studies have shown that organizations with robust SCRM strategies report improved health outcomes due to reduced stockouts and improved access to medical resources (Kaur & Singh, 2021). Therefore, integrating SCRM into healthcare operations is essential for achieving sustainable health outcomes.

Positive Relationship between Information Technology Capability and Health Outcomes

Supply Chain Risk Management (SCRM) positively influences health outcomes by ensuring the resilience and reliability of healthcare supply chains. Effective SCRM minimizes disruptions, enhances resource availability, and ensures the timely delivery of critical medical supplies, which directly impacts the quality of health services (Fan & Stevenson, 2018). By identifying and mitigating risks such as delays, shortages, and quality issues, organizations can maintain a consistent flow of essential resources, which improves patient care and health outcomes. Moreover, SCRM fosters collaboration among stakeholders, leading to better coordination and responsiveness in addressing emergencies or unforeseen disruptions (Gong et al., 2020). This is particularly vital during crises, such as pandemics, where efficient risk management can save lives. SCRM practices, such as risk assessment, contingency planning, and supplier diversification, contribute to reducing vulnerabilities and enhancing the overall performance of healthcare systems (Ho et al., 2021). Empirical evidence further supports this positive relationship. For example, studies have shown that organizations with robust SCRM strategies report improved health outcomes due to reduced stockouts and improved access to medical resources (Kaur & Singh, 2021). Therefore, integrating SCRM into healthcare operations is essential for achieving sustainable health outcomes.

Positive Moderating Role of Information Technology Capability in the Relationship Between Supply Chain Risk Management and Health Outcomes

Information Technology Capability (ITC) plays a critical moderating role in strengthening the relationship between Supply Chain Risk Management (SCRM) and health outcomes by enabling efficient risk mitigation and enhancing operational resilience. ITC provides real-time data and advanced analytics tools, which improve the ability to identify, assess, and respond to supply chain risks proactively. For instance, robust IT systems can track inventory, forecast demand, and detect potential disruptions, ensuring the continuous availability of essential medical supplies and services (Bharadwaj, 2020). In the context of healthcare, ITC facilitates seamless communication and data sharing among supply chain stakeholders, thereby enhancing coordination and reducing the time required to address supply chain issues (Wang et al., 2021). The integration of IT solutions like cloud computing and Internet of Things (IoT) devices allows healthcare organizations to

monitor supply chain performance in real-time, improving decision-making and ensuring timely responses to risks. Empirical evidence indicates that organizations with higher IT capabilities achieve better health outcomes, particularly when faced with supply chain disruptions. ITC enhances the adaptability and resilience of supply chain processes, ensuring that risks are managed effectively and patient care remains uninterrupted (Reddy et al., 2019). Moreover, ITC fosters innovation in risk management practices, such as predictive modeling and automated alerts, which significantly improve the overall effectiveness of SCRM strategies. By providing the tools necessary to manage risks efficiently, ITC amplifies the positive impact of SCRM on health outcomes, making it an indispensable component of modern healthcare supply chain strategies.

5. Conclusion

The study determined the effect of Supply Chain Risk Management on Health Outcomes and the findings of the study concluded that there is a strong and significant positive relationship between Supply Chain Risk Management and Health Outcomes, supported by robust statistical metrics. The findings underscore the importance of effective risk management strategies in enhancing health-related services and outcomes, offering valuable insights for both organizational and policy-level interventions. The study examined the relationship between information technology capability and health outcomes and the findings of the study concluded that there is a significant and strong positive relationship between Information Technology Capability and Health Outcomes, with Information Technology Capability explaining a substantial portion of the variance in Health Outcomes. The findings highlight the importance of robust IT systems, infrastructure, and management in enhancing healthcare delivery and outcomes. This underscores the need for continuous investment in IT capabilities to drive efficiency, improve patient satisfaction, and achieve superior health outcomes. The study assessed the moderating role of Information Technology Capability in the relationship between Supply Chain Risk Management and Health Outcomes and the findings of the study concluded that there is a positive and significant moderating role of Information Technology Capability in the relationship between Supply Chain Risk Management and Health Outcomes. This underscores the importance of leveraging IT capabilities to enhance the effectiveness of SCRM practices, ultimately improving health outcomes.

5.1 Managerial Implication

The findings of this study, highlighting the positive and significant moderating role of Information Technology Capability (ITC) in the relationship between Supply Chain Risk Management (SCRM) and Health Outcomes, offer valuable insights for managers. First, ITC enables organizations to improve their ability to identify, assess, and mitigate supply chain risks. By leveraging robust IT systems, organizations can integrate real-time data analytics, predictive modeling, and automation to enhance visibility and responsiveness throughout the supply chain. This ensures timely interventions and minimizes disruptions, thereby promoting better health outcomes. Second, the

study underscores the importance of investing in IT infrastructure and employee training to strengthen IT capabilities. Managers must prioritize the adoption of scalable and flexible IT solutions that align with the organization's long-term goals. These technologies enable seamless communication and collaboration with supply chain partners, improving risk-sharing and collective decision-making processes. This collaborative approach not only mitigates risks more effectively but also fosters resilience, leading to enhanced service delivery and, consequently, improved health outcomes.

5.2 Theoretical Implication

First, the study reinforces and extends the existing body of literature on supply chain management and healthcare outcomes by introducing ITC as a critical moderator in this relationship. The findings suggest that while SCRM is inherently focused on identifying, assessing, and mitigating risks, the presence of strong IT capabilities enhances the effectiveness of these activities, particularly within complex and dynamic environments such as healthcare. This theoretical framework expands our understanding of how technology influences operational processes and their outcomes. Secondly, the study contributes to the theoretical discourse on the intersection of IT capabilities and supply chain resilience. Traditional supply chain risk management models often emphasize risk identification and mitigation strategies but fail to account for the role of technology in enabling these processes. By demonstrating that ITC moderates the relationship between SCRM and health outcomes, the research proposes an integrated view where IT acts not only as a tool for operational efficiency but also as a strategic enabler of health outcome improvement.

5.3 Recommendations

Healthcare organizations should prioritize investment in robust IT infrastructure to ensure their supply chains are equipped to handle dynamic risks effectively. By enhancing IT capabilities, such as real-time data monitoring, predictive analytics, and automated risk detection, organizations can improve the efficiency and responsiveness of their risk management processes. This is crucial in health systems, where timely responses to supply chain disruptions can directly impact patient care and health outcomes. Regular upgrades to IT systems should be a priority to stay ahead of technological advancements and better address emerging risks. Organizations should integrate IT into their existing supply chain risk management frameworks.

5.6 Suggestions for Future Studies

Future research could explore the role of ITC in supply chain risk management within specific industries beyond healthcare. While this study focuses on healthcare outcomes, other sectors such as pharmaceuticals, manufacturing, or retail may present different dynamics in how IT moderates the SCRM-health outcomes relationship. Studying these different sectors could provide a more comprehensive understanding of the generalizability of the findings. Given the increasing role of advanced IT solutions like artificial intelligence (AI), blockchain, and machine learning in

enhancing supply chain management, future studies could investigate the specific impact of these technologies on SCRM and health outcomes.

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