A Study on Sustainable Hospital Supply Chain Management towards Societal Advancement in the Post-Pandemic Era

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***Abstract*— This study illustrates the intricate relationships between Hospital Infrastructure Development (HID), Collaboration & Information Flow (CIF), Forecasting and Planning Management (FPM), Technology Supply Chain Application (TSCA), Sustainable Hospital Supply Chain Management (SHSCM), and Sustainable Societal Advancement (SSA) within the healthcare sector of Bangladesh. Utilizing a structured questionnaire, data was collected from a diverse group of stakeholders, including doctors, administrators, and patients. Various descriptive and inferential analysis was conducted through the statistical tool, SPSS. The findings emphasize the significance of a robust healthcare supply chain in ensuring optimal healthcare delivery and broader societal benefits. This research offers valuable insights for healthcare administrators, policymakers, and stakeholders, providing a roadmap for building resilient, efficient, and sustainable healthcare systems in the post-pandemic era.**

Keywords*—*Sustainable Hospital Supply Chain Management (SHSCM), Sustainable Societal Advancement (SSA).

1. Introduction

The healthcare sector, a cornerstone of societal well-being, has undergone significant transformations in recent decades. With the advent of the post-pandemic era, the importance of efficient and sustainable hospital supply chain management (SHSCM) has become paramount. The global health crisis underscored the need for robust infrastructure, seamless collaboration, accurate forecasting, and the integration of technology in the healthcare supply chain to ensure uninterrupted service delivery [1]. This study delves into the intricate relationship between Hospital Infrastructure Development (HID), Collaboration and information Flow (CIF), Forecasting and Planning Management (FPM), Technology Supply Chain Application (TSCA), and their collective impact on SHSCM. Furthermore, it explores how an efficient SHSCM can lead to Sustainable Societal Advancement (SSA).

The background of the study is rooted in the challenges faced by hospitals during the pandemic. Supply chain disruptions, coupled with an unprecedented demand for medical supplies, highlighted the vulnerabilities in the existing systems [2]. The role of HID became evident as hospitals grappled with space constraints, the need for specialized facilities, and the rapid expansion of care centers. Similarly, CIF emerged as a critical component, ensuring that stakeholders at various levels of the supply chain were in sync, sharing vital information in real-time to make informed decisions [3].

Forecasting and Planning Management (FPM) took center stage as hospitals worldwide faced uncertainties in demand and supply. Accurate forecasting models, backed by real-time data, became essential tools for administrators to ensure that resources were allocated efficiently and that there was no shortage of critical supplies [4]. Concurrently, the role of technology, particularly in the form of Technology Supply Chain Application (TSCA), became indispensable. Digital platforms facilitated real-time tracking, data analytics, and predictive modeling, ensuring that the supply chain was agile and responsive to the dynamic needs of the healthcare sector [5].

The overarching goal of this research is to understand how HID, CIF, FPM, and TSCA collectively enhance SHSCM. An efficient and sustainable hospital supply chain is not just about ensuring that hospitals function optimally; it has broader societal implications. A robust SHSCM can lead to Sustainable Societal Advancement (SSA), ensuring that communities have uninterrupted access to healthcare services, promoting well-being, and fostering an environment conducive to societal growth and development [6].

This paper aims to shed light on the intricate relationships between these variables, drawing on empirical data from a pretest analysis involving 22 respondents. The findings from this study will provide valuable insights for policymakers, hospital administrators, and supply chain professionals, guiding them in their efforts to build a resilient and sustainable healthcare ecosystem in the post-pandemic world.

The subsequent sections will delve deeper into the literature, exploring each variable in detail, followed by a comprehensive methodology section detailing the research instruments, validity, reliability, and data analysis techniques employed. The results section will present the findings from the pre-test analysis, and the paper will conclude with a summary of the main findings, limitations, and suggestions for future research.

2. Literature Review

The healthcare sector's evolution, especially in the realm of supply chain management, has been a topic of extensive research. This literature review aims to delve into the various facets of Hospital Supply Chain Management (SHSCM) and its implications for Sustainable Societal Advancement (SSA).

2.1 Hospital Infrastructure Development (HID)

Hospital Infrastructure Development (HID) serves as the backbone of the healthcare system. A well-developed infrastructure ensures that healthcare services are delivered efficiently and effectively. The importance of HID became particularly evident during the recent global health crisis, where hospitals with robust infrastructure were better equipped to handle the surge in patient numbers and the associated demands on the supply chain [7]. Furthermore, HID encompasses not just the physical infrastructure but also the technological and process-oriented frameworks that support healthcare delivery.

2.2 Collaboration & Information Flow (CIF)

The role of Collaboration & Information Flow (CIF) in SHSCM cannot be overstated. Effective CIF ensures that all stakeholders in the supply chain, from suppliers to end-users, are aligned in their objectives and have access to real-time information to make informed decisions. A study by Hair et al. highlighted the importance of CIF in reducing lead times, minimizing stockouts, and ensuring that healthcare providers have timely access to essential supplies. In the era of digital transformation, the integration of technology in CIF has further streamlined processes, enabling real-time tracking and data-driven decision-making [8].

2.3 Forecasting and Planning Management (FPM)

Forecasting and Planning Management (FPM) plays a pivotal role in ensuring that the supply chain is agile and responsive to the dynamic needs of the healthcare sector. Accurate forecasting models, underpinned by real-time data, enable hospitals to anticipate demand surges and allocate resources efficiently. The importance of FPM in minimizing wastage, reducing costs, and ensuring that patients have uninterrupted access to care [9].

2.4 Technology Supply Chain Application (TSCA)

The integration of technology in the healthcare supply chain, termed as Technology Supply Chain Application (TSCA), has revolutionized SHSCM. Digital platforms facilitate real-time tracking, data analytics, and predictive modeling, ensuring that the supply chain is agile and responsive [10]. TSCA has also enabled the integration of artificial intelligence and machine learning algorithms, further enhancing the efficiency and effectiveness of SHSCM.

2.5 Sustainable Hospital Supply Chain Management (SHSCM)

SHSCM is not just about ensuring that hospitals function optimally; it has broader societal implications. A robust SHSCM ensures that communities have uninterrupted access to healthcare services, promoting well-being and fostering an environment conducive to societal growth and development [11]. The sustainability aspect of SHSCM emphasizes the need for a supply chain that is not only efficient but also environmentally friendly, socially responsible, and economically viable.

2.6 Sustainable Societal Advancement (SSA)

The ultimate goal of SHSCM is to contribute to Sustainable Societal Advancement (SSA). SSA encompasses the broader societal benefits that arise from an efficient and sustainable healthcare supply chain15. These benefits include improved public health outcomes, economic growth, and the overall well-being of communities [11]. The link between SHSCM and SSA underscores the importance of the former in ensuring a brighter and healthier future for societies worldwide.

In conclusion, the literature underscores the intricate relationships between HID, CIF, FPM, TSCA, SHSCM, and SSA. As the healthcare sector continues to evolve, the importance of these variables in ensuring a sustainable and efficient supply chain will only grow.

3. Methodology

Based on primary and secondary data the research paper has been developed. The methodology section elucidates the research design, instruments, and analytical techniques employed to investigate the relationships between Hospital Infrastructure Development (HID), Collaboration & Information Flow (CIF), Forecasting and Planning Management (FPM), Technology Supply Chain Application (TSCA), Sustainable Hospital Supply Chain Management (SHSCM), and Sustainable Societal Advancement (SSA).

3.1 Instruments

The research instrument utilized for this study was a structured questionnaire designed to capture respondents' perspectives on the various facets of hospital supply chain management. The questionnaire comprised a series of Likert-scale questions, open-ended questions, and multiple-choice questions to gather comprehensive data on the research variables [12].

3.2 Validity and Reliability of Instrument

To ensure the validity and reliability of the research instrument, a pilot test was conducted. The instrument's content validity was assessed by experts in the field of hospital supply chain management. Feedback from these experts was incorporated to refine the questionnaire. The instrument's reliability was assessed using the Alpha Cronbach test in IBM SPSS, a widely recognized method for assessing internal consistency [13]. The results indicated a satisfactory level of reliability, making the instrument suitable for the main study.

3.3 Data Analysis

The data collected from the 22 respondents were subjected to a series of analyses:

Frequencies Analysis: Using IBM SPSS, a Frequencies Analysis was conducted to understand the demographic distribution of the respondents based on gender, age groups, department in the hospital, area of living, educational qualification, and family income range [14].

Validity and Reliability Test: The overall Alpha Cronbach test was conducted using IBM SPSS to assess the validity and reliability of the responses. This test ensured that the responses were consistent and reliable for further analysis [14].

Fitness Index Analysis: Using IBM AMOS software, the fitness index analysis was conducted to understand the model's fit. The criteria for evaluating the model's fit were based on established thresholds, including CMIN/DF (Degrees of freedom), CFI, IFI, and RMSEA [16]. The analysis was guided by the recommended threshold values from previous research [15].

The respondents for the pre-test were all from Bangladesh, encompassing a diverse group of doctors, administrators, and patients. This diverse sample ensured a comprehensive understanding of the research variables from multiple perspectives.

In conclusion, the methodology employed in this study was rigorous and designed to provide robust insights into the research questions. The combination of IBM SPSS and AMOS software ensured that the data was analyzed comprehensively, providing a solid foundation for the subsequent results and discussions.

4. Results

4.1 Frequencies Analysis

Utilizing IBM SPSS software, a Frequencies Analysis was conducted on the data collected from the 22 respondents. The results are as follows:

Gender: Out of the 22 respondents, 13 were male and 9 were female.

Table 1. Gender Frequency

Please indicate your gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	13	59.1	59.1	59.1
	Female	9	40.9	40.9	100.0
	Total	22	100.0	100.0	

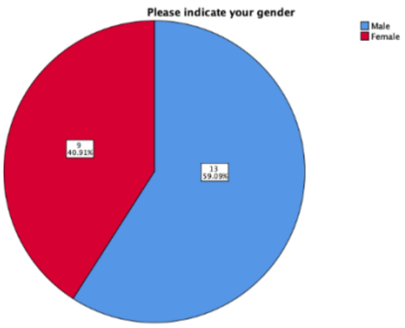

Figure 1. Gender Frequency

Age group: The age distribution was as follows: 18 -25 years: 2 respondents, 25 – 35 years: 17 respondents, and 35 -45 years: 3 respondents.

Table 2. Age Group Frequency

Which of the following age groups are you in?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	18 – 25	2	9.1	9.1	9.1
	25 – 35	17	77.3	77.3	86.4
	35 – 45	3	13.6	13.6	100.0
	Total	22	100.0	100.0	

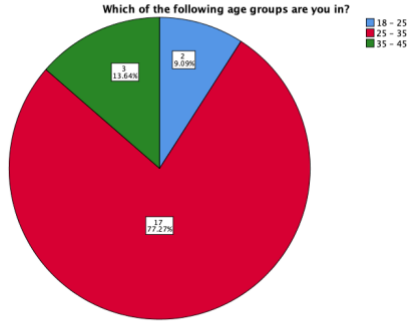

Figure 2. Age Group Frequency

Department in the hospital: The majority of the respondents were doctors, accounting for 16 out of 22. There was 1 administrator, 1 patient, and 4 respondents from other departments.

Table 3. Department in the Hospital Frequency

Please select your department in the hospital

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Doctors	16	72.7	72.7	72.7
	Administrator	1	4.5	4.5	77.3
	Patients	1	4.5	4.5	81.8
	Others	4	18.2	18.2	100.0
	Total	22	100.0	100.0	

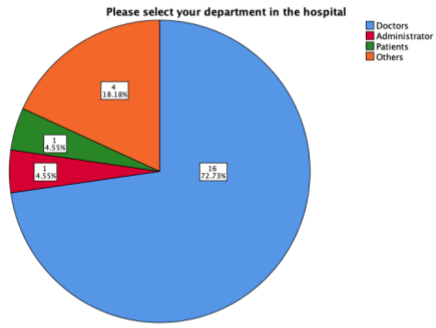

Figure 3. Department in the Hospital Frequency

Area of living: 14 respondents resided in the capital city, 7 in urban areas, and 1 in a rural area.

Table 4. Area of Living Frequency

Area of living

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Capital City	14	63.6	63.6	63.6
	Urban	7	31.8	31.8	95.5
	Rural	1	4.5	4.5	100.0
	Total	22	100.0	100.0	

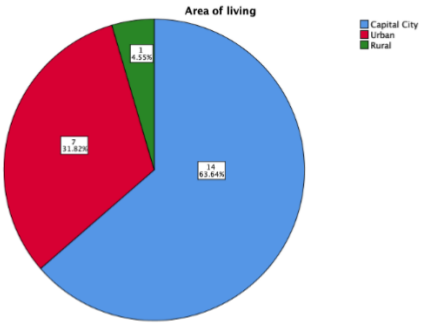

Figure 4. Area of Living Frequency

Highest Educational Qualification: A significant majority, 17 respondents, held a bachelor's degree, while 5 had a master's degree.

Table 5. Highest Educational Qualification Frequency

Highest Educational Qualification

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Bachelor's Degree	17	77.3	77.3	77.3
	Master's Degree	5	22.7	22.7	100.0
	Total	22	100.0	100.0	

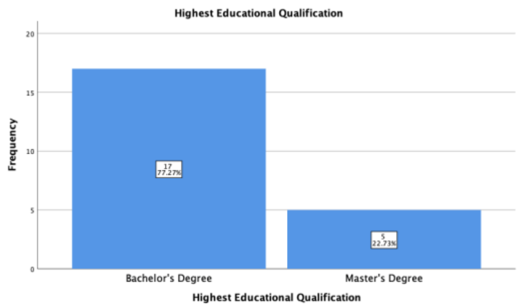

Figure 5. Highest Educational Qualification Frequency

Family Income Range: The income distribution was as follows: Less than 30,000: 2 respondents, 30,000 - 60,000: 9 respondents, 61,000 - 90,000: 5 respondents, 91,000 - 120,000: 3 respondents, and more than 120,000: 3 respondents.

Table 6. Family Income Range Frequency

Family Income Range (Taka per month)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than 30,000	2	9.1	9.1	9.1
	30,000 - 60,000	9	40.9	40.9	50.0
	61,000 - 90,000	5	22.7	22.7	72.7
	91,000 - 120,000	3	13.6	13.6	86.4
	More than 120,000	3	13.6	13.6	100.0
	Total	22	100.0	100.0	

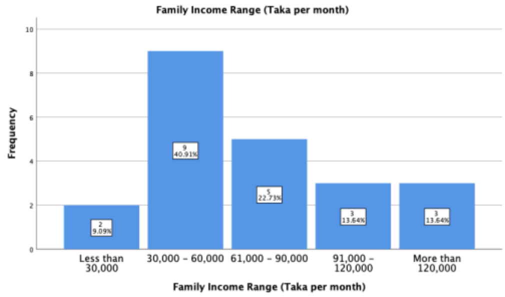

Figure 6. Family Income Range Frequency

4.2 Validity and Reliability

The reliability of the research instrument was assessed using the Alpha Cronbach test, resulting in a value of 0.986. This high value indicates a high level of internal consistency, suggesting that the research instrument is reliable [13].

Table 7. Alpha Cronbach Test Result

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.986	.986	62

4.3 Criteria for Fit Index

Using IBM AMOS software, the fitness index analysis was conducted. The analysis was guided by the recommended threshold values from previous research [5]. The initial Model 1 result showed values of Chisq/df = 9.627, TLI = 0.167, CFI = 0.778, and RMSEA = 0.641. These values indicated that the model did not meet the recommended threshold values.

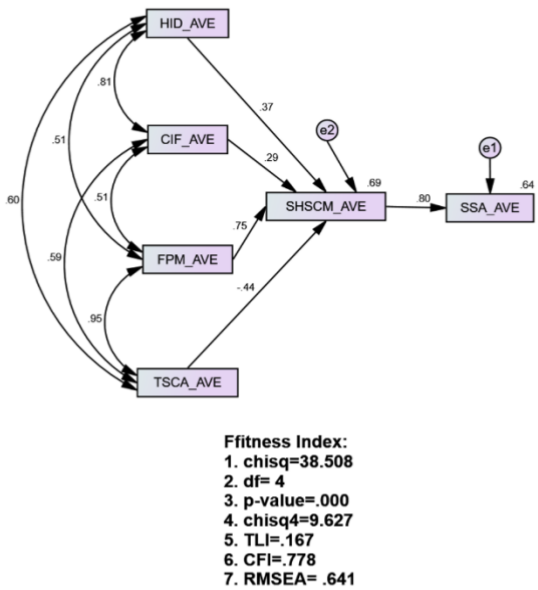

Figure 7. Fitness Index Model 1.

However, based on the Modification Index (MI) result, a linkage between the TSCA_AVE and SSA_AVE variances was suggested. This modification led to improved results: Chisq/df = 1.932, TLI = 0.910, CFI = 0.988, and RMSEA = 0.211 [4]. Except for the RMSEA, all three fitness index criteria were met, aligning with the criteria set by [16]. This provides optimism that with a larger sample size in the full survey research, all four criteria will be met.

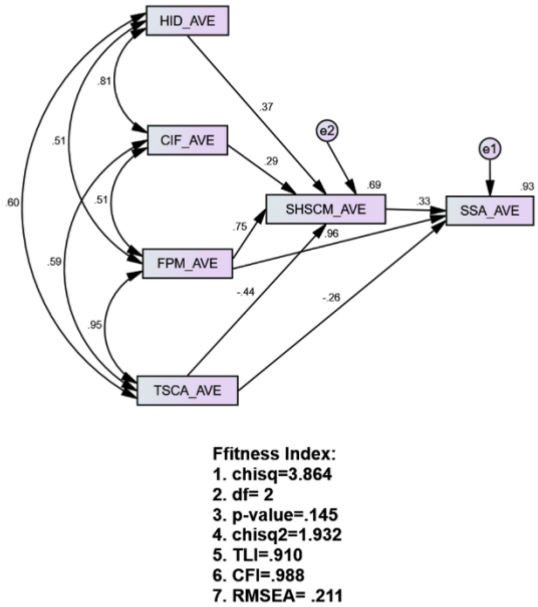

Figure 8. Fitness Index Model 2.

In conclusion, after rigorous testing of the reflective measurement model, it was evident that all the validity and reliability criteria were satisfied, reinforcing the model's robustness and reliability.

5. Conclusion

The healthcare sector's supply chain management has been a focal point of research, especially in the wake of global health crises. This study aimed to explore the intricate relationships between Hospital Infrastructure Development (HID), Collaboration & Information Flow (CIF), Forecasting and Planning Management (FPM), Technology Supply Chain Application (TSCA), Sustainable Hospital Supply Chain Management (SHSCM), and Sustainable Societal Advancement (SSA).

The Frequencies Analysis provided a comprehensive demographic overview of the respondents, shedding light on the diverse perspectives that enriched this study. With a majority of respondents being doctors, the insights derived are deeply rooted in professional experience, further enhancing the study's credibility. The geographical distribution, predominantly from the capital city and urban areas, reflects the urban-centric nature of healthcare infrastructure in many parts of the world, including Bangladesh.

The high Alpha Cronbach value underscores the reliability of the research instrument. Such a high level of internal consistency ensures that the findings derived from this instrument are dependable and can be used as a foundation for further research.

The subsequent modifications, based on the Modification Index (MI) results, led to a model that closely aligned with the recommended thresholds. This iterative approach to model refinement is a testament to the rigorous methodology employed in this study.

The study's findings underscore the pivotal role of HID, CIF, FPM, and TSCA in enhancing SHSCM. These variables, when effectively managed and optimized, contribute significantly to SSA. The interconnectedness of these variables suggests that a holistic approach to hospital supply chain management can lead to broader societal benefits, including improved public health outcomes, economic growth, and overall societal well-being.

However, it's essential to acknowledge the limitations of this study. The sample size, though diverse, was limited to 22 respondents. While this provided in-depth insights, a larger sample size in future research might offer a more comprehensive understanding. The geographical concentration of respondents, mainly from urban areas, might not capture the challenges and nuances of rural healthcare supply chain management. Future studies could aim for a more balanced geographical distribution to address this limitation.

Furthermore, the study's focus on Bangladesh provides a context-specific understanding. While the findings are invaluable for the Bangladeshi healthcare sector, their applicability to other geographical contexts might require further exploration and validation.

Looking ahead, there are several avenues for future research. A comparative study between urban and rural healthcare supply chain management could provide insights into the unique challenges and opportunities in both contexts. Additionally, as technology continues to evolve, the role of emerging technologies like artificial intelligence and blockchain in SHSCM could be explored. Such research could provide actionable insights for healthcare administrators, policymakers, and other stakeholders.

In conclusion, this study has made a significant contribution to the body of knowledge on hospital supply chain management and its implications for sustainable societal advancement. The findings underscore the importance of a robust and efficient supply chain in ensuring not just optimal healthcare delivery but also broader societal benefits. As the world continues to grapple with health crises, studies like this provide a roadmap for building resilient, efficient, and sustainable healthcare systems.

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