

MAJOR FACTORS AFFECTING SUPPLY CHAIN INTEGRATION IN HEALTHCARE INDUSTRY FOR BETTER RESPONSE TO PANDEMIC COVID-19

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Abstract

Hospital supply chains were severely affected by the widespread transmission of COVID-19 over the past years. Hospitals are under pressure due to a lack of various healthcare supplies in recent years and hence the situation is appropriate for measuring supply chain processes, important to the healthcare system. This study proposes to test the applicability of associative and relational alliance strategies for healthcare supply chains. Production planning, operational planning, and demand forecasting have been identified as three key factors in the healthcare supply chain and their effects on the relationship between hospitals and suppliers have been examined in this study. Hospital-supplier associations play an important role in enabling these three factors, to exercise positive impact on the healthcare industry's performance. The study found strong correlation between the three factors and better operational performance.

Keywords: Supply chain, Resources collaboration, Hospital-supplier chain and Healthcare Industry

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1. Introduction

In today's hyper-competitive world, customers, particularly patients, value services from other service-oriented organizations more than hospitals (**Dasgupta, et al., 2016**). To remain competitive and profitable, hospitals must improve customer service, update sourcing and increase operational efficiencies. Surgical, medical, and laboratory supplies, drugs and equipment are important components of a hospital's operating budget. In other words, efficient planning and sourcing of such material is critical for the hospital to save money and better serve patients and customers (**Chen, et al., 2013**).

2. Review of Literature

The term, Hospital Supplier Association, is used to describe how a hospital can integrate its suppliers to reduce costs and improve service (**Frohlich & Westbrook, 2001**). Benefit-sharing has been deemed essential in supply chain by some researchers (**Cao & Zhang, 2011**). **Sarkis, et al., (2011)** argued that good information sharing can be used for planned production and replenishing key ingredients or resources (**Ramanathan, 2012; Ramanathan & Muyldermans, 2010**). The production planning association is more important for hospitals because it helps them order and secure critical medicines, machines and other equipment, that may be critical in the future, due to seasonal ailments and weather conditions (**Bennet, et al., 2011 and Ahmadi, et al., 2015**). Cooperation between suppliers and hospitals can reduce inventory and thus costs (**Grötsch, et al., 2013**). Further, it can enhance operational transparency and economies of scale as hospitals integrate supply chain vendors and suppliers (**Ahmadi et al., 2015; Stolze, et al., 2016**).

Demand forecasting can create value (**Song and Parola, 2015**), by facilitating timely information sharing. Demand forecasting helps replenish perishable and low-shelf-life products (**Aviv, 2007**). It also helps plan and execute unique marketing activities like new product or service introductions, discounted tests, or special health packages (**Ramanathan, 2012**).

3. Statement of the Problem

The coronavirus outbreak disrupted global supply chains in recent years, causing a shortage of vital medical and personal protective equipment on the front lines. This caused front-line workers' fears and raised concerns about the sustainability of healthcare. COVID-19 has revealed several supply chain vulnerabilities, including lack of PPE and test kits (**Bhaskar et al., 2020**). The manufacturing and automotive industries were pioneers in the practice of analyzing supply chains as a potential source of strategic advantage or asset. According to **Dobrzykowski and Tarafdar (2015)**, other industries had adopted and incorporated these lessons into their operations, reducing unnecessary costs and waste.

While the services sector learned this aspect gradually and imbibed the best practices the healthcare industry worked more on the importance of supply chain inventory and the availability of critical instruments or drugs than overall process efficiency (**Baltacioglu, et al., 2007; Beckman & Sinha, 2005**). The hospitals must work on efficient supply chain formulation since rising input costs, and operational costs, would increase the stress on the profitability of these hospitals (**Chen et al., 2013**).

4. Need of the Study

The recent outbreak of the COVID-19 pandemic had placed additional strain on the already stressed supply chains of the healthcare industry. As a result, hospitals in particular were forced to deal with shortages of both essential and less important supplies and medications. In the wake of the global COVID-19 pandemic, many businesses worldwide had entirely redefined their work environments and made it clear how critical it was to respond rapidly, reconfigure swiftly, and establish crisis management systems to deal with them. In the early days of the pandemic, urgent situations arose due to acute limitations and lockouts but after the end, many companies were on a recovery mode and are now preparing for the long term (Khot, June 06, 2020). Therefore, it is indeed the most opportune time to undertake a study, that evaluates the criticality of key supply chain functions, that will help these hospitals serve their patients and customers better in normal and new normal times like the present.

5. Objectives of the Study

- ♦ To determine whether there is positive influence of production planning on hospital-supplier association.
- ♦ To determine whether there is positive influence of operations planning on hospital-supplier association.
- ♦ To determine whether there is positive influence of demand forecasting on hospital-supplier association.
- ♦ To determine whether there is positive influence of hospital-supplier association on the operational efficiency of hospitals.

6. Hypotheses of the Study

The authors proposed to test the following hypotheses in this study :

- H1:** There is positive influence of production planning on hospital-supplier association.
- H2:** There is positive influence of operations planning on hospital-supplier association.
- H3:** There is positive influence of demand forecasting on hospital-supplier association.
- H4:** There is positive influence of hospital-supplier association on the operational efficiency of hospitals

7. Research Methodology

Healthcare supply chain has many meanings. First, these supply chains operate in many areas, from procuring APIs and raw materials to manufacturing drugs and supplying hospitals and pharmacies. At the same time, another stream refers to nutraceuticals, where the focus lies on procuring, creating, and selling nutritional and preventive healthcare products. Out of the various diverse stakeholders in the healthcare supply chain, the authors chose only the hospitals, pharmacies, chemists, and medical equipment and surgical equipment suppliers.

7.1 Sample Selection

The data for the study were collected from online portals such as medindia, hospital-management, medicards and they were further refined, by contacting them personally over the phone. In addition, a mix of the healthcare supply chain stakeholders was contacted, by using convenience sampling from four major cities in Rajasthan. Further, to decide on the exact variables for the study, the literature survey and the work of prior researchers, were employed.

Thus production planning operations planning, and demand forecasting, were chosen, as the variables, to represent the significant aspects of the hospital supply chain. The operational efficiency of the hospitals was determined, by using the previous studies' standards and the respondents' impressions, through a structured questionnaire, that was adapted mainly from **Ramanathan & Gunasekaran, (2014)**.

7.2 Source of Data

This study was earlier undertaken in the field of textiles industry but the constructs were suitably modified to reflect the business nuances of a healthcare business. The questionnaire comprised statements, that measured the respondents' answers towards different constructs, on a seven-point Likert Scale, with 1 being strongly disagreed to 7 strongly agreed, and 4 being neutral. The questionnaire was validated, with a pilot study of 25 respondents, comprising ten hospitals, eight medical and surgical equipment manufacturers, and seven chemists and pharmacies.

7.3 Period of Study

The study was done during the period from October, 2021 to December, 2021. The study was accomplished, without compromising the rules of Covid 19, as instructed by the Government of India.

7.4 Tools used in the Study

Once the questionnaire was deemed appropriate and valid, it was sent via email and social media, with a response rate of 229 (**Table-1**). To decode the effect of the three constructs on the Hospital Supplier Association and to further understand the effect of the association on hospital operational efficiency, the structural equation modelling model was developed as shown in **Figure-1**.

8. Data Analysis & Discussion

After the questionnaire was validated with a pilot study and the final responses of the respondents were recorded, the data were analyzed, with the first step being to check the collected data's reliability. As shown in **Table-2**, the threshold value of the individual items and the composite reliability coefficients were all above 0.7, proving the validity of the individual items used in the questionnaire. It is critical to check for construct validity while validating a proposed model for checking the effect of independent variables on the dependent variable, through an intermittent variable. This can be done by evaluating unidimensionality, convergent validity, and discriminant validity. **Table-2** shows that all items, loaded on their respective factors, recorded values greater than 0.7, indicating unidimensionality.

Further, as critical ratios (CR) exceeded the minimum required value of 2 (with minimum CR= 9.132), the minimum standardized factor loading (0.756) being more than the threshold of 0.5, and the lowest average variance extracted (AVE = 0.667) being over the threshold of 0.5, it proved the convergent validity. According to **Table-3**, with a minimum average variance of 0.667, there was more inter-construct correlation coefficient than inter-construct squared variance, thus proving discriminate validity. **Table-4** displays the results of the hypothesis testing. As the standard coefficients and t-values revealed, all the hypotheses were accepted.

Therefore, with the results of hypotheses testing and the values of the standard coefficients, that are shown in **Table-4**, it is clear that under the proposed model, the supply chain factors did influence the operational efficiency of hospitals and the same can be demonstrated with the required values, as displayed in **Figure-2**.

9. Findings of the Study

The tests conducted on the data and the results of Structural Equation Model, demonstrated that the three constructs proposed in the study, such as production planning, operations planning, and demand forecasting, did have positive and significant influence on the hospital – supplier association, with all the three factors reporting significant values of 0.296, 0.351 and 0.236.

10. Suggestion of the Study

People's lives and medical supply chain were both affected by COVID-19's widespread transmission over the recent years. Hospitals, together with their vendors, need to consider both internal and external factors while forecasting medical supply demand. Currently, there are only few warehouses available in the country and the majority of them are located in metropolitan areas while smaller cities still lack this facility. In addition, warehouses are typically located in the centre of the city, making it difficult to get supplies to other parts of the city from their location. Regardless of the size of the city, it is absolutely necessary to construct additional warehouses in order to be prepared for a pandemic. It is essential for all pharmaceutical companies to coordinate their efforts with those of the government, in order to prevent any disruptions in the supply of medications.

11. Conclusion

In order to better serve patients, the hospital and its suppliers, both upstream and downstream, need to work together to improve the efficiency of day-to-day operations. This is where the operations planning association comes in. Following the operations planning association is the production planning association, which is harder to achieve but can yield significant results

if hospitals can estimate their supplier needs more precisely. The least significant impact of demand forecasting is on the hospital–supplier relationship. Since most hospitals today work with multiple suppliers and buyers, demand forecasting in terms of marketing activities, pharma sales, bed occupancy and lab utilization may not affect one supplier or vendor in the entire supply chain. The Hospital – Supplier Association affects hospital operational efficiency significantly (0.411), as tests revealed that if hospitals and their suppliers could coordinate their production plans, operations and demand forecasting, then operational efficiency would improve, as there would be less wastage, the cost of acquiring supplies would decrease, and the extra capacity could be used more efficiently.

12. Limitations of the Study

An emphasis was placed on North India in this research and hence these findings cannot be used as the basis for generalizations. There are other parts of India where the same study could be conducted. In addition, only hospitals and medical suppliers were used in this study to better understand the supply chain. but customer feedback could also be used to better understand the supply situation.

13. Scope for Further Research

Due to the evolving COVID-19 pandemic effect and the unified and individual response of governments of the world, the healthcare industry is in a flux. This is a once-in-a-lifetime black swan event and humans have no experience fighting a pandemic. Vaccine distribution has already begun worldwide since last year, including India. Hence a study of this process, along with the current variables, might give better results to understand the supply chain and logistics functions of this industry.

14. References

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Table-1: Description of Respondent Profile in Healthcare Industry

Respondent Category	No of Respondents Targeted	No of Responses Received
Hospitals	136	87
Chemists & Pharmacies	117	74
Medical & Surgical Equipment Manufacturer	103	68
Total	356	229

Source: Primary Data computed using SPSS

Table-2: Results of Reliability & Uni-dimensionality Test

Construct	Variable	Standard Loadings	t - value (CR)	SMC	CR Alpha	Composite Reliability	AVE
Production Planning	PP 1	0.817	10.221	0.668	0.882	0.918	0.675
No of Items = 5	PP 2	0.831	9.132	0.692			
	PP 3	0.857	13.038	0.735			
	PP 4	0.795	16.712	0.621			
	PP 5	0.812	12.514	0.662			
Operations Planning	OP 1	0.756	15.031	0.561	0.872	0.921	0.695
No of Items = 5	OP 2	0.812	18.238	0.657			
	OP 3	0.889	16.521	0.791			
	OP 4	0.874	13.418	0.755			
	OP 5	0.842	15.038	0.711			
Demand Forecasting	DF 1	0.881	17.641	0.782	0.893	0.921	0.708
No of Items = 5	DF 2	0.872	19.531	0.767			
	DF 3	0.825	14.032	0.685			
	DF 4	0.795	12.475	0.631			
	DF 5	0.812	16.326	0.665			
Hospital Supplier Association	HSA 1	0.785	13.225	0.612	0.865	0.913	0.667
No of Items = 5	HSA 2	0.825	16.836	0.675			
	HSA 3	0.836	19.712	0.706			
	HSA 4	0.792	18.534	0.632			
	HSA 5	0.851	14.276	0.725			
Operational Efficiency	OE 1	0.856	18.807	0.733	0.882	0.923	0.747
No of Items = 4	OE 2	0.895	16.235	0.795			
	OE 3	0.874	14.826	0.758			
	OE 4	0.837	12.368	0.695			

Source: Primary Data computed using SPSS

Table-3: Results of Correlation Coefficients of the Construct showing the Relationship

Construct	Mean	Standard Deviation	x1	x2	x3	x4	x5	AVE
Production Planning(x1)	3.97	0.84	1					0.675
Operations Planning(x2)	3.68	1.09	0.372	1				0.695
Demand Forecasting(x3)	4.09	0.87	0.354	0.391	1			0.708
Hospital Supplier Association (x4)	3.82	1.03	0.411	0.457	0.306	1		0.667
Operational Efficiency(x5)	3.76	0.94	0.281	0.315	0.265	0.285	1	0.747

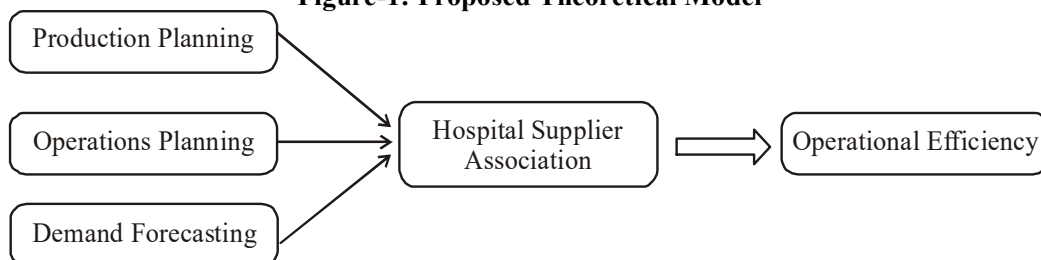
Source: Primary Data computed using SPSS

Table-4: Results of Hypotheses Testing

No	Path	Standard Coefficient	C.R. (t-value)	Result
H1	Production Planning - Hospital Supplier Association	0.296	6.925	Accepted
H2	Operations Planning - Hospital Supplier Association	0.351	7.283	Accepted
H3	Demand Forecasting - Hospital Supplier Association	0.236	4.685	Accepted
H4	Hospital Supplier Association - Operational Efficiency	0.411	7.894	Accepted

Source: Primary Data computed using SPSS

Figure-1: Proposed Theoretical Model



Source: SPSS & Partial Least Square Output

Figure-2: Validated Model for Effect of Major Supply Chain Factors on Hospital Supplier Association & Operational Efficiency of Hospital



Source: SPSS & Partial Least Square Output