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IMPROVING SUPPLY CHAIN PERFORMANCE IN THE SOUTH AFRICAN HEALTHCARE SERVICE: A LITERATURE BASED PERSPECTIVE

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ABSTRACT

Supply chain performance management plays an imperative role in keeping healthcare organizations sustainable and competitive by handling the storage and efficient distribution of resources in the value chain. Managing the complexity of healthcare demands and the application of improved technologies requires best practice supply chain models. The South African healthcare industry experiences unsatisfactory capacity limitations where there are extreme deficiencies of beds, equipment, facilities and trained healthcare professionals. This study highlights supply chain management strategies that can enhance efficient healthcare accessibility and delivery in South Africa using literature data. The results show that advanced healthcare delivery approaches such as ambulance divert and predictive analytics stand a good chance of improving supply chain management in the country.

Keywords: Supply chain performance, healthcare, supply chain frameworks, supply chain improvement

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1 INTRODUCTION

Healthcare institutions are indispensable in ensuring timely response to human infirmities and improved quality of life. Owing to increasing challenges in the value chain, healthcare organizations are always searching for opportunities to improve operational planning and lessen costs. The patient care procedures in medical institutions are bolstered by a scope of operational tasks that incorporate stock management and dispersal of supplies. Medical facilities carry a lot of varied items, which portends inalienable difficulties of storing items and distributing them around the healthcare supply chain. A good supply chain management (SCM) system is therefore critical towards achieving and sustaining high standard patient care [1]. The internal supply chain in medical clinics is described by its intricacy, distinctiveness, and operational complexity. For example, there are extremely costly items and medical equipment utilized in operating rooms, challenging stock tracking precisely from the barrage of treatments, and uncertain demand for medical supplies [2]. The deployment of SCM best practices in the medical services sector can both identify physical supplies needs as well as advance patient care [3].

Traditionally, SCM is charged with the responsibility of ensuring the availability of the right item in the desired amount at the required time [4]. Recent investigations show that a huge portion of the expenses connected with supply chains in the healthcare division can be decreased by implementing efficient supply chains [5]. Literature reveals that integrating Lean in the hospital SCM is value adding as it has the potential to reduce supply chain cost, improve instrument utilization, patient safety, and medication distribution systems [6][21]. Despite dynamic market conditions, to date, numerous organizations utilize SCM strategies due to their ability to integrate various stakeholders (suppliers, management, distributors, customers and manufacturers) in the supply chain ensuring that production, procurement, and distribution needs are met at the least possible cost. Yang et al [7] studied the impact of deploying demand-driven supply chain strategies (which includes supply chain intelligence, organizational capabilities, customer knowledge and integration, information sharing, and collaboration) on a just-in-time supply chain systems. The study suggests that customer-driven strategic sourcing improves sourcing efficiency which supports cost reduction as well as JIT supply chain management objectives. [7].

The South African (SA) healthcare industry is poised with unique divisions. The SA medical system has a two-layered medical framework comprising of the public and private segments. The state-owned public medical institutions provide primary and secondary healthcare; while the exorbitant private medical services serve mainly those who can afford the cost. For the start, primary healthcare is carried out on the principles of the District Health System [9]. Concerted efforts have been made towards easing healthcare provision and administration in SA since the end of apartheid, yet the tenacious imbalances and the liability of subdivisions are still obvious [10]. As Maphumulo & Bhengu [8] highlighted, an array of problems have been raised by the public regarding public healthcare institutions..." prolonged waiting time because of the shortage of human resources, adverse events, poor hygiene, and poor infection control measures, increased litigation because of avoidable errors, shortage of resources in medicine and equipment and poor recordkeeping" [8].

More recently, some quantitative and qualitative models have been proposed for the efficient running of the healthcare supply chain. A supply chain performance forecast framework to estimate slacking measurements based on leading metrics to anticipate performance dependent on casual relationships [11] has been advocated. An understanding of past suggestions of researchers on the SCM strategies that can better the healthcare system is key to streamlining healthcare management in SA, in line with the observations of Rodrigues and Carpinetti [11]. This paper attempts to update SCM in healthcare services in SA through a



review of recent global SCM literature. In our own opinion, insight from the study can drive SCM in SA healthcare sector towards more efficient health service delivery.

2 RESEARCH METHODOLOGY

The study utilized a quantitative research approach and relied mainly on secondary data abstracted from existing literature. Components and concepts were recognized and explained. In delineating pertinent data needed for the study, the keywords that are associated with the research topic were typed into the search engines of the identified repositories. Specifically, online books, journals, and conference materials were acquired using databases such as Engineering village, Science direct, Google Scholar, Scopus, Emerald, and Pubmed, though not every material accessed and read made the analysis list. The following keywords "Supply Chain Performance", "supply chain performance in healthcare", "healthcare supply chain", "South Africa healthcare supply chain" and "improving supply chain in healthcare" were all used to populate the dataset. A sum of 86 datasets was originally selected from the aforementioned search. This number was subjected to further rounds of sorting and filtering, after which about 65 were considered for analyses and 21 withdrawn completely. The withdrawal was either due to unfitness after careful evaluation against the criteria used, or inability to address the problem adequately.

This category of articles includes monographs, book chapters and other non-peer-reviewed publications such as online materials/periodicals. The reason behind the withdrawal of some peer-reviewed articles published in high impact journals was their inability to address the issues that underlie healthcare supply chain performance or at least healthcare SCM frameworks in the studied area. Hence, those selected in this category was for the sake of providing a general background to the conversations on supply chain performance improvement frameworks. In the end, most of the data that survived the final selection came from Science direct. We did not consider this to be an issue, since all the journals possess high impact standing. The literature was tabularized into categories of sub-themes that stressed the intention, results and area of application of some of the reviewed papers. However, some of the references cited in the introduction and other areas that did not meet the purpose of the thematic categorization were not inserted in the aforementioned table. Recommendations arrived at, were based on the most frequent and tested procedures drawn from a good representative of the data accessed and analysed.

3 LITERATURE REVIEW

The supply chain management (SCM) phrase was initially introduced and later defined and popularised in the nineteenth century by Oliver and Webber [12] and has since been advanced by other researchers [13-14]. The technology has since received good acceptability in almost every industry. Supply Chain Management is used in factories, workshops, engineering establishments, etc, for proper management of inventory. The technology has been extended to containment of the global financial crisis (GFC) cost performances and logistics [15-16] and cost minimization Logistics scheduling [17]. The authors suggest that in hostile extrinsic conditions, low capital expenditure can lead to processes being overvalued. Liu et al [18] maintain that the choices of inventory networks are not always impacted by the loss-averse predispositions. However, the application of manageable inventory chain administration does not automatically enhance expenditure [19-20]. The ideal batch size has a connection with various manufacturing phases and optimal batch size can lessen expenditure [21-22].

The range of resources needed for efficient healthcare discharge have compelled researchers to have key interest in the implementation of SCM in healthcare delivery, while others are signalling the need to find deep-rooted factors that influence healthcare supply chain integration [23]. The SCM system in hospitals, in comprehensive terms, encapsulates regular



supply of consumables and tools, the quality, responsiveness and efficiency of both services and maintenance process. The healthcare sector requires to get the essential services and material supplies just when they need it, how they need it, where they need it, and at the best price and quality specification [24]. The Healthcare supply chain can be complex because of numerous features and intricate management demands of patients and other stakeholders of the sector.

4 OVERVIEW OF SUPPLY CHAIN PERFORMANCE MEASUREMENT AND FRAMEWORKS

A performance management framework can keep track of the efficacy of firms' operations techniques [25]. Ample research has been done in areas of capacity development, correlated frameworks, inventory and transportation management [26-28] and regions yearning to pursue strategic supply chain administration. Before 1980, cost accounting frameworks were utilized which depended on quantitative cost-related measurements [29]. Later on, the frameworks were intensified thus the extent concerning the cost related measurements was broadened to incorporate operational efficiency and various roles in the supply chain [30].

A balanced scorecard that deciphers the company's technique in quartet standpoints: economic, client, company procedures, plus instruction along with development was created in the 1990s [31]. Supply chain performance measurement literature is vast, therefore, this presentation ordered information into two categories specifically, financial performance estimation systems and non-financial performance estimation systems. Further we discuss other cost analysis strategies, capacity issues and performance metrics.

4.1 Financial Performance Estimation Systems

These frameworks uses traditional accounting methods for estimating SC performance. The conventional cost accounting frameworks were created under the circumstances where large scale manufacturing was the most appropriate production framework while the reduction of expenses was achieved via scale economies [32]. The two main financial performance estimation systems are economic value added (EVA) and Activity-Based Costing (ABC).

The economic value added (EVA) is a methodology for evaluating the earnings to add up to capital expenditures. It is a computation of an organization's actual income since it completely represents the expenses concerning all sorts of investments, in contrast to accounting wages. Altaf [33] declares that the EVA as a performance estimation almost gauges the actual financial advantage of an organization and is legitimately connected to the investor's worth.

Activity-Based Costing (ABC) utilizes a substantial amount to assignment foundations to calculate the expenses of the tasks that dominate the assets. The ABC frameworks are regarded as highly-priced due to the large numbers of price pools needed, the necessity of uniform evaluations, and the expense of application [34-35]. However, these cost accounting measures have been criticised due to its inability to include other non-financial parameters which are of strategic relevance like operating performance, product quality and customer satisfaction [36].

4.2 Non-financial Performance Estimation Systems

Unlike the financial measures which are short term, historical and profit oriented, the new balanced integrated system which included nonfinancial SCPM is long-term and customer oriented [36]. Based on their measurement criteria, the non-financial SCPM methods are classified into nine. The Function-based Performance Systems (FBMS) which evaluates functions within each SC; Dimension-based Performance Systems (DBMS) which measures pre-determined KPIs throughout the supply chain; Hierarchical-based Performance Systems (HBMS) for assessing all three management levels - Operational, Tactical and Strategic; Interface-based Performance Systems; Perspective-based Performance Systems to assess the six SC perspectives of Logistics, Operations Research, Marketing, System Dynamics, Organization and



Strategy; Efficiency-based Performance Systems to assess the SC efficiency; SC Balanced Scorecard (SCBS) Performances measures which cuts across the four supply chain perspectives; and the (SCOR) Performance Model which evaluates the five main SC processes[36]

SCOR Model

The SCOR model (Supply Chain Operations) established by the Supply chain (SC) council is a system for measuring the reliability and proficiency of inventory network. It characterizes a SC by utilizing the combined indexes such as Plan, Source and Make, Deliver and lastly, Return of items. The final estimation is on resources, which cover the potential to effectively make use of assets [37]. Tramarico et al [39] executed a multiple-criteria instruction appraisal for Green supply chain management throughout the quartet superior tasks of the SCOR model. Okongwu et al [40] posed a unified system that is based on the SCOR representative and the customer order decoupling point. Other researchers [38] combined the SCOR model and fuzzy TOPSIS to assess SC while [41] discussed the use of a fuzzy QFD methodology to sustain SCOR KPIs with empirical industrial case research. Akkawuttiwanich & Yenradee [41] developed the practical activities to be administered to reach the set score KPIs. Their findings reveal that the organization may not acquire the aimed KPIs at the end because the association between "What's" and "How's"(technical improvement actions) may have been communicated inaccurately. Research efforts bordering on SC balanced scorecards initiated in 1992 are well documented [30] [42] [43-44].

4.3 Other Cost Analysis Strategies in SCM

In SCM, numerous expenses can affect the presentation as a whole, including the cost of acquisition, manufacturing, standard, transportation, stock, etc. These expenses affect the execution of the supply chain in all industries and have been investigated by researchers. For example, Wong, Chan, and Wadu, [45] presented some understanding on the elements that are significant in improving green acquirement in the construction business and propose a strategic direction for successful endorsement of green attainment [46]. Customer prerequisites in rendering and administration or non-administration company necessities are the variables that were recognized in ecological guidelines. Wong and co-authors inferred that the absence of green acquirement principles as well as constrained green resources have limited its improvement. Shafiei-Kisomi et al [47], presented a combined scientific plan of action dependent on the robust optimization theory to limit the total expenses of the inventory chain by regulating a collection of distributors, shipping quotas and position provision. The model is simple and worked successfully, though may incorporate a huge level of vulnerability in the production network. Petterson and Segerstedt [48], contrast SCC based on definite expense collated to evaluated quality cost. Akhtari et al [49] duplicate representative for two stock frameworks that are order-up-to-level together with fixed order quantity, and Moschuoli et al (2019) [50] fuzzy set model are very good examples of SCC formulations.

4.4 Capacity Issues in SCM

Capacity administration as a performance indicator in SCM plays the role of initiating and alternating capacity degree to execute production plans. Capacity assessment is performed for asset management, matching facility type and degree of equipment utilization for various processes, and determining rough-cut volume. Dominiguez et al [22] examine the vigorous conduct of a controlled system inventory chain with volume limitations in both the assembling and re-assembling lines. The issue of resource availability and establishing the volume required in public healthcare facilities have been discussed [51], as well as automated SC [52].

4.5 Performance Metrics

The performance metrics involve critical analysis of how various industries manage their cost and capacity constraints in the overall SCM. Performance metrics provide distinction for firms



and assists in making choices. Furthermore, they analyze the adequacy and proficiency of organization projects. Cost and capacity choices are important performance indicators that can drive an organization to the ground. The cost metric is a bigger measure than all metrics combined because companies and businesses constantly need to assess their performance, resource utilization and the financial state. It can demonstrate the value of a team. Techniques like Return on Investment (ROI) and Earned Value (EV) are widely used in industries. Moreover, the ROI concentrates on assessing the determined advantage of a process while the earned value focuses on giving tactical guidance on how much an organization has made from the money invested in a task. Capacity management empowers organizations to prepare ahead, administer assets proficiently and react to company prerequisites faster. Costs can be minimized when capacity is utilized adequately.

5. CURRENT STATE AND PROSPECTS FOR IMPROVEMENT

Capacity management is a fundamental segment of current healthcare governance as it significantly affects the hospital's financial robustness. It includes the procurement and distribution of high expenditure assets that involve personnel and stock. To improve capacity, South African emergency clinics can evaluate the volume of space accessibility and the patient demand whereby medical facilities can close and open sections as required, based on the patient's capacity. Healthcare organizations are required to have suitable capacity planning to diminish the effect of low bed volumes and personnel capacities which is currently obtainable in the sector. In the SA context, bed usage, and the proportion of beds in emergency clinics are still a challenge [53]. Aligning demand to supply demands can be advantageous for healthcare facilities in S.A and would reduce overpopulation. Patient movement produces irregular inter-correlated demand for Operating rooms.

Emergency department care is under strain due to the high volume of patients in need of care. Unplanned incomers need surgery as well as urgent care. Patient discharges usually occur in the evenings and this generates variations in the demand and supply for beds and healthcare employees. Patients who additionally arrange surgeries for the future also make demand fluctuate. The suggestion is that medical facilities need to implement the ambulance divert system. This is when the ambulances are notified to transport patients to neighbouring medical centres in good time due to the inadequacies in taking the patient to the original destination. This can make for efficient operation management that is not pressured and strenuous to healthcare staff, despite creating a better management scheme for patient's care. High managerial staff turnover and personnel shortages are severely impacting healthcare supply chain efficiency in South African leading to a delayed response to responsibilities [53-54]. Healthcare facilities are best prescribed to retain a collection of caregivers as back up to fill up the gaps for the unscheduled non-attendance. Furthermore, medical care centres have implemented RFID to improve the accessibility of information, comprehend and manage demand. This innovation will generate a database that is bound to recognize the position of the patient, staff member, and machinery [55]. This can steer to a refined capacity and staffing.

In sum, implementing predictive analytics in the South African healthcare industry can assist in meeting the enormous demand for healthcare in the public sector. Predictive analytics is a process of erudition from recorded information to create estimations about unknowns [69]. Information history that can be utilized in predictive analytics is computerized anonymous medical history and related groupings. This framework can be utilized to anticipate patient entry in frequent interims and can permit the medical care personnel to enhance patient movement that will in turn better the supply chain performance of healthcare institutions in the Country.

Table 1 presents the healthcare supply chain literature categorization and the areas considered in the analysis.



Table 1: Literature categorization, outcomes and application

Author(s)	Objective	Outcome	Area of Application	Country and Type of healthcare
Khosravi and Izbirak (2019) [56]	SCM social sustainability estimation Stakeholder theory based framework	sustainability indices for Suppliers, Patients, Patient relatives, Employees, Government & Decision makers	Various wards of a general (Government) hospital	Iranian healthcare located in Tehran
Subramanian et al., (2020) [57]	Quantifying healthcare SC sustainability	Metrics for determining stakeholder collaboration, operations quality and footprints of economic, environmental and social aspects of sustainability	Promotion of improvement in the valuation and health reporting of public health supply chains	Proof-of-concept study for further research on public healthcare SC.
Hussain et al., (2018) [58]	Identification of motivators, barriers, and promoters of social sustainability in healthcare SC	Consideration of all stakeholders in establishing SC social sustainability in healthcare helps in meeting expectations of all involved	Stakeholders made up of suppliers, patients/community, employees, and owners government	United Arab Emirates various departments of 10 hospitals
Reda et al. (2020) [59]	Exploration of Blockchain techniques in healthcare SC.	Implementation of blockchains in the healthcare SC sphere	Status of Blockchain in Challenges and benefits of SCM in health care	Conceptual, can be tested as part of further studies
Rowan and Laffey (2020) [60]	Reducing the Shortage of critical health workers equipment	Measures for safeguarding SC critical equipment	Healthcare personnel and Personal protective equipment	Republic of Ireland; Sterile Services Department of a Regional Hospital
Govindan et al. (2020) [61]	Management of demand in healthcare SC	knowledge and fuzzy inference system based decision support framework for SC demand management: Supports the potency of the proposed framework	Risk level of community stakeholders	General applicability in healthcare systems
Kochan et al.	Applicability of Cloud computing	cloud-based information distribution improves healthcare supply	Simulated hospital supply chain behaviour.	No validated empirical data used:



Author(s)	Objective	Outcome	Area of Application	Country and Type of healthcare
(2018) [62]	technologies in healthcare SCM	chains performance and visibility	Models generalized to an ideal hospital supply chain setting	
Moons et al. (2019) [1]	Development of SC Performance Indicators in operating rooms	Analytic network process based Decision support Framework for measurement of SC performance in operating rooms	Inventory and internal distribution policies in hospital settings	Not validated on empirical data
Golec and Karadeniz (2020) [63]	competency-based Quantification of SCM in healthcare vis-a-vis operation evaluation	Evolution of a Fuzzy model that measures competency and operation of SCM	Measurement of SCM performance and evaluation of activities of five selected hospitals	Bishkek, Kyrgyzstan Public healthcare system
Khan et al. (2018) [64]	Categorizing dimensions of motivation and its impact on healthcare SC social sustainability	Proposition of a measurement and structural models to evaluate impacts of identified dimensions	social sustainability in healthcare SC	United Arab Emirates: 207 surveys from healthcare units
Skipworth et al. (2020) [65]	Effect outsourcing on healthcare supply chains	Strengthened knowledge base on outsourcing in health care SC	Public-to-private outsourcing Public-to-public outsourcing	Italy: Regional Health Service outsourcing
Imran et al. (2018) [66]	Development of an optimal medicine supply chain model for integrated healthcare systems	Model gave satisfactory results on cost, time and quality of supplied medicine	Model functionality was demonstrated on a hypothetical numerical example	The researchers are affiliated to institutions in South Korea and Pakistan
Dillon et al., (2017) [67]	Inventory management in the blood supply chain model.	Reduction of wastage and overall expenditure in the absence of bargaining the administration degree.	Healthcare	Australia
Nasrabadi et al.,	Healthcare facility uncertainties in location and	The importance of strong arrangement in	Healthcare	Canada



Author(s)	Objective	Outcome	Area of Application	Country and Type of healthcare
(2020) [68]	capacity planning	keeping up the suitable administrative degree.		
Mapowo et al., (2018) [69]	Incorporating product classification in the Visibility and Analytics Network (VAN)	Product categorization: methods and significance in the SA public health	Public Healthcare pharmaceutical supply chain	South Africa
Scavarda et al., (2019) [70]	Tripod Sustainable Healthcare SCM Frameworks	Theory, Practice and implementable policies	sterilization service department and the stockroom in the supply chain	Rio de Janeiro Brazil: Private healthcare

6 CONCLUSION

This study provides a summary of supply chain performance improvement opportunities from literature-based information. The research is limited in coverage since non-financial performance frameworks from allied industries were not extensively reviewed. The work covered some part on implementing predictive analytics to control demand fluctuations in healthcare, however, there is a knowledge gap on the impact of predictive analytics on supply chain performance in other industries which future research can investigate.

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