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STRENGTHENING PHARMACEUTICAL DISTRIBUTION CHAIN IN KENYA: A CASE STUDY OF THE KENYA MEDICAL SUPPLIES AUTHORITY AND DAGORETTI SUB-COUNTY HOSPITAL

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MBA-HCM/120695/19

Submitted in partial fulfillment of the requirements for the award of Degree of Master of Business Administration in Healthcare Management at Strathmore University

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December 2021

Approval

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ABSTRACT

The increasing demand for medical products continues to put pressure on pharmaceutical supply chains, jeopardising the health system's goal of universal access to safe, effective, quality, and affordable commodities. Evidence-based supply chain management interventions could help address the majority of the challenges.

Using the case of Kenya Medical Supplies Authority (KEMSA) and Dagoretti Sub-County Hospital (DSCH), this research aimed to identify factors that affect the performance of Kenya's public health sector pharmaceutical distribution chain and identify areas for improvement. Specifically, the study aimed to (i) characterize the pharmaceutical distribution value chain linking the central medical store (KEMSA) and use point (DSCH), (ii) identify all non-value-add steps/processes and activities throughout the value chain, and (iii) propose an alternative distribution chain that could perform a similar function with higher effectiveness.

A cross-sectional qualitative study design was used to collect data using key informant interviews. Qualitative data was managed in NVIVO and analysed following a thematic approach.

Findings highlight four key activities that characterise the pharmaceutical distribution chain in the public sector: 1) demand for pharmaceutical products, 2) procurement, 3) warehousing, and 4) distribution. Besides, the study identified the adoption of technology, training of staff, collaboration between KEMSA and DSCH/counties among the most important value-adding factors. However, having fewer KEMSA distribution facilities and the use of manual procurement activities were identified as the primary non-value-add process reducing the performance of the pharmaceutical distribution chain in the public sector in Kenya.

The study, therefore, recommends a shift from a manual procurement process to an online system to improve efficiency by reducing delays in the tendering process. Besides, KEMSA should consider expanding the network of distribution facilities across the country to enhance ease of access to pharmaceutical commodities, enhancing efficiency in service delivery whilst reducing the logistical costs and delays in transporting commodities.

TABLE OF CONTENTS

VT OMNES VNVM SINT

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

COVID-19	:	Corona Virus Disease
DQA	:	Data Quality Analysis
DSCH	:	Dagoretti Sub County Hospital
ERP	:	Enterprise Resource Planning
FIFO	:	First In First Out
IFMIS	:	Integrated Financial Management Information System
IS	:	Information Systems
IT	:	Information Technology
KEMSA	:	Kenya Medical Supplies Authority
LMIS	:	Logistics Management Information Systems
MEDS	:	The Mission for Essential Drug Supplies
MOU	:	Memorandum of Understanding
NGO	:	Non-Governmental Organisation
NVA	:	Non-Value Adding Activities
QA	:	Quality Assurance
SC	:	Sub-County
SCM	:	Supply Chain Management
UHC	:	Universal Health Coverage
VA	:	Value Adding Activities
VAT	:	Value Adding Time
VSM	:	Value Stream Mapping

VT OMNES VNVM SINT

Acknowledgement

I would like to acknowledge my supervisor, Dr Francis Wafula, for his support and guidance to ensure that I finished this document. My gratitude goes to the Health care workers at Dagoretti Sub County Hospital and the staff at the Kenya Medical Supplies Authority (KEMSA) for their support in collecting data and finally my family for their support and encouragement.

Dedication

This Document is dedicated to my family: My lovely husband; Dr. Charles Lelei, for the immense support and encouragement, my wonderful children; Liam, Lianna and Lavinia, for giving me reason to keep going.

I also dedicate it to Dad; Dr. Daniel Ng'eno, Mum; Mrs. Sarah Ng'eno, Sister; Sandra Ng'eno and brothers; Kelvin Kirui, George Leleito and Giddeon Marindany for the continuous prayers and support.

CHAPTER ONE: INTRODUCTION

1.1 Introduction

This chapter gives an overview of Supply Chain Management and the pharmaceutical Supply chain highlighting the Pharmaceutical Supply Chain in Kenya in light of the national and international health system goals/targets.

1.2 Background Information

Access to essential medicines has been identified as an essential building block of a well-performing health system (WHO, 2010a) and a significant factor for achieving universal health coverage (UHC) (WHO, 2010b; Wirtz et al., 2017). UHC is a critical target 3.8 of the UN-championed Sustainable Development Goal 3: Good health and wellbeing (Network, 2018; Pablos-Mendez, Cavanaugh, & Ly, 2016). In agreement with these international health principles, the Kenyan Constitution of 2010 also grants every person the right to access the highest attainable healthcare standards (Kenya, 2014). The realization of these goals, including UHC, requires reforms in all health systems, including the pharmaceutical supply chain. The pharmaceutical supply chain is a crucial determinant of healthcare provision and patient outcomes, accounting for 20 – 60% of healthcare costs (Ongarora et al., 2019). In order to ensure access "to safe, effective and quality medicines and health products" by the whole population, a robust supply chain that ensures a safe, secure, and efficient supply of pharmaceutical commodities and technologies across the healthcare system is needed (Vledder, Friedman, Sjöblom, Brown, & Yadav, 2015).

The pharmaceutical supply chain is a component of the broader supply chain management (SCM) with origins in the logistics field. The concept of SCM was introduced by Michael D. Weber and R. Keith Oliver in the early 1980s to contribute to better coordination of organizational functions with suppliers (Felea & Albăstroiu, 2013). By definition, SCM refers to an efficient process of integrating main business activities and processes by trading partners from the point of acquiring raw materials to delivering products to customers for value creation and sustained competitive advantage (Wisner, Tan, & Leong,

2014). In operational terms, it involves the flow of materials and products (Habib, 2010). SCM has also been defined as a practice domain, discipline domain, or both (Dwyer, 2011). Nevertheless, SCM tends to have standard components, including activities and processes, people and materials, products or services, and their flow from an organization to customers (Felea & Albăstroiu, 2013). Therefore, SCM plays a significant role in building external relationships between partners in the whole supply chain by managing the flow of information, products, and services.

The pharmaceutical supply chain refers to the movement of pharmaceuticals from the manufacturers to end-users, and it involves a complex network of players, processes, information, and resources (Ongarora et al., 2019). At the top are the manufacturers who ensure that sufficient pharmaceuticals are produced, followed by the distribution activity that involves multiple players, including local distributors, importers, wholesalers, retailers, and health facilities. These players provide a crucial link between the manufacturers and consumers (Ikundo, 2007). The government and research organizations also act as essential stakeholders performing various roles in the pharmaceutical industry, such as regulation and research and development (R&D).

In Kenya, the pharmaceutical distribution chain plays a crucial role in improving access to medicines. Most healthcare facilities are centralized in urban centres despite nearly 78% of Kenyans living in rural areas (Kariuki, Njeru, Wamae, & Mackintosh, 2015). It particularly became more critical following the devolution of Kenya's health care sector under Article 176 of the Kenya Constitution of 2010 to address these disparities (Kenya, 2014). Currently, the national government addresses healthcare issues at the national level, including developing healthcare policies and managing national public health facilities, such as referral hospitals (Kariuki et al., 2015). Conversely, the county governments are responsible for the provision of primary and secondary care and management of county public healthcare facilities. The Kenya National Health Policy proposes a tiered system with an effective upward referral system from the community to national referral hospitals to link these two levels of healthcare governance (Kenya, 2014).

At the core of achieving these health care goals is the Kenya Medical Supplies Authority (KEMSA). Established in 2000 as a government corporation and replacement of the defunct Medical Supplies Coordinating Unit, it is mandated to procure, store, and distribute pharmaceutical products and other medical supplies to public healthcare facilities (KEMSA, 2013). Both county and national governments procure from KEMSA to achieve economies of scale and strengthen operations (Anne & Juliana, 2019). The post-devolution engagements are anchored on the KEMSA Act of 2013, where KEMSA coordinates and creates a relationship with county governments in the distribution of pharmaceutical supplies. KEMSA liaises with the county governments to establish and maintain appropriate supply chains to effectively distribute drugs and medical supplies (KEMSA, n.d.)The Authority also gathers information on the efficiency of its processes essential in assessing supply chain performance. Due to the expanded Kenyan health system and increased demand for medical supplies, other players in the private sector complement KEMSA's distribution activities (F. N. Wafula, Miriti, & Goodman, 2012). The Mission for Essential Drugs and Supplies (MEDS), a faith-based agency, is a significant entity that supplies faith-based and non-governmental organisations (NGOs). It also supports KEMSA in supplying some public facilities on request. On the other hand, private suppliers mainly sell to private facilities across the country, and together they facilitate access to pharmaceutical supplies.

The disruptions caused by technology and the quest to generate customer value also emphasize the supply chain's role in promoting organization performance in the pharmaceutical industry (Cardinal, 2001; Onyango, 2020). The sector is experiencing new challenges as the demands of the global economy continue to rise. Compliance, effective risk management plans, and excellent operations have become essential issues in the pharmaceutical industry (Bravo & de Carvalho, 2013). For example, adapting to new forms of organisational processes and stricter adherence to set regulations makes production and distribution liable to heavy civil penalties (Gronauer, Scherrer-Rathje, & Friedli, 2009). The utilisation of risk assessment management frameworks, such as quality-by-design (QbD), has also led to a significant reduction in drug recalls and returns (Bravo & de Carvalho, 2013). Thus, to keep the supply chain competitive, pharmaceutical

firms should shift to a proper understanding of SCM. Value Stream Mapping has been proposed as a key approach to adequately understanding the performance of SCM systems in the health sector (Abideen & Mohamad, 2020; Dixit, Routroy, & Dubey, 2021; Sremcev et al., 2019) and other sectors (Acero, Torralba, Pérez-Moya, & Pozo, 2020; Gunduz & Fahmi Naser, 2017; Nwanya & Oko, 2019) globally. Against this backdrop, this study focussed on the structural and human factors that interact and influence the performance of the supply chain in the public sector that in return determine the availability and cost of pharmaceutical commodities. The factors were examined following the value stream mapping lens, particularly highlighting the value-add and non-value-add activities within the SC.

1.3 Problem Statement

A good supply chain, vital for expanded access to essential medicines, needs to be efficient, adaptable, and with high financial integrity (Yadav, 2015). However, supply chains in many low- and middle-income countries (LMICs), including Kenya, face a myriad of bottlenecks hindering progress towards UHC (Kariuki et al., 2015). Past studies have found that the pharmaceutical sector faces many challenges, such as poor quality products, exorbitant prices, and persistent shortages and stock-outs of essential pharmaceutical products that act as barriers to access to high quality and affordable healthcare (Cameron, Ewen, Ross-Degnan, Ball, & Laing, 2009; Organisation, 2008). These problems have been attributed mainly to inefficiencies in the supply chain (Yadav, 2015). However, there is little evidence on the specific nature of inefficiencies in the Kenyan pharmaceutical supply chain and how they can be minimised. Other factors such as proximity to health facilities, acceptability, and regulatory safeguards on pharmaceutical product quality and costs have also contributed to limited access to pharmaceutical supplies in LMICs (Ongarora et al., 2019). For example, (Kapoor, Vyas, & Dadarwal, 2018) noted that the diverse nature of players involved in pharmaceutical distribution and heavy regulation on aspects, such as mergers and acquisitions to meet R&D demands, make supply chain management very difficult. Furthermore, there is a broad mismatch of objectives, drivers, and constraints between the pharmaceutical manufacturing and distribution chain to the end-user (Kapoor et al., 2018).

In Kenya, medicines shortages and stock-outs are fairly common at public health facilities and remain relatively unaffordable in cases where they are available (Kariuki et al., 2015; Yadav, Institute, & Michigan, 2014). KEMSA and other partners have made significant investments to enhance and integrate its procurement operations and processes. For example, KEMSA has made significant strides in undertaking staff capacity building and integrating technology to improve its services (Yadav et al., 2014). The National Hospital Insurance Fund (NHIF) also bought more ambulances to boost the distribution of medical supplies to health facilities from KEMSA warehouses (Wasikea & Mugambi, 2015). Despite these interventions, several factors have been cited for contributing to the continued underperformance of KEMSA's pharmaceutical distribution chain. Bureaucracies at KEMSA have been the main factors impeding the organisation from achieving its mandate over the decades (Yadav et al., 2014). Media information has also suggested political interference and corruption as the main threats to KEMSA operations (Ayega, 2020; Omboki, 2020). However, a critical look at the KEMSA's operations has identified limitations, such as procurement deficiencies and lack of personnel training and necessary skills essential for performing critical distribution functions (Kazi, 2012; Muhia, Waithera, & Songole, 2017; Yadav et al., 2014).

At the devolved units, a significant improvement in medicines availability has been noted in counties like Embu due to increased staffing and personnel training on commodity management and technology use, to strengthen forecasting and quantification to reduce stock-outs (Sabbaghi & Sabbaghi, 2004). The change in KEMSA's supply system from the push system (where KEMSA would supply facilities based on standard pre-defined kits with a one-size-fits-all assumption) to a pull system (where facilities and counties quantify their own needs and place orders based on that) has also to a larger extent reduced drug stock-outs (Kanyangi, 2018). Nevertheless, the counties have continued to grapple with human resources deficiency, lack of enough skilled personnel, and the high cost of pharmaceutical products, among other factors that affect pharmaceutical distribution (Kimathi, 2017). The rapidly growing pharmaceutical supply network in Kenya is also believed to lead to a lack of planning for optimal performance and the attainment of UHC goals (Ramana, 2017).

These shortcomings highlight a need for designing appropriate interventions that build on operations management tools to improve supply chain performance. Therefore, this study is central to understanding the role of pharmaceutical distribution in the public health sector by evaluating the factors affecting the distribution chain in the Kenyan public health sector through value stream mapping (VSM) and identifying the appropriate improvement strategies.

1.4 Study Aim and Objectives

1.4.1. Aim

To examine factors affecting the performance of the pharmaceutical distribution chain in Dagoretti Sub County Hospital and KEMSA,Kenya and propose a more effective alternative model for improved supply chain performance.

1.4.2. Specific objectives

1. To characterize the pharmaceutical distribution value chain linking the central medical store (KEMSA) and use point (Dagoretti Sub-County Hospital (DSCH).
2. To identify non-value-add steps/processes and activities throughout the value chain.
3. To develop and validate an alternative distribution chain model that both minimizes non-value-add activities and processes and fits well with the current policy context.

1.5 Research questions

1. What characterizes the pharmaceutical distribution value chain linking the central medical store (KEMSA) and use point (Dagoretti Sub-County Hospital)?
2. What are the non-value-add steps/processes and activities throughout the value chain?

3. What is the alternative distribution chain model that both minimizes non-value-add steps/processes and activities and fits with the policy context?

1.6 Significance of the Study

There is limited research on the performance and effectiveness of the supply chain in the public health sector in Kenya despite the medicine shortages and stockouts in health facilities in Kenya. By examining the distribution chain between KEMSA and DSCH, this study will help to address this research gap. The findings will provide essential data to the Ministry of Health, the KEMSA management, and healthcare facilities to enhance pharmaceutical supply chain performance in Kenya. The study will also provide crucial information to policymakers for consideration during the development of pharmaceutical supply chain-related policies. Besides, the proposed model is expected to help improve pharmaceutical SCM in Kenya and similar settings. Finally, the proposed research will build the academic literature on SCM in LMICs.

1.7 Scope of the Study

The study was conducted in Nairobi County, Kenya, where KEMSA and DSCH are located. The target population comprised of KEMSA and DSCH staff involved in the pharmaceutical distribution activities, including ordering, procurement, and supply. The variables investigated included influencing factors of the pharmaceutical supply chain as the independent variables and performance as measured by the number of cycles completed, turnaround time, and availability of drugs as the dependent variables. Data was obtained from records and the perspective of selected participants from KEMSA and DSCH.

1.8 Operational definition of terms

Value Stream Mapping: A lean management tool that uses a flowchart to document activities in every process

Stock outs: situation where the demand of a product exceeds its supply due to the product being unavailable in the warehouse

Supply Chain Management: an efficient process of integrating main business activities and processes by partners from the point of acquiring commodities to delivering them to customers for value creation.

Agility: It refers to flexibility, responsiveness, and quickness in managing daily operations in SCM

Value-add Activities: Activities and processes within the supply chain that enhance and improves efficiency of the process

Non-Value-add activities: activities and processes within the supply chain that hinders efficiency of the process

Structural Factors: factors related to the supply chain's design, considering the supply chain's efficiency, agility, and flexibility.

Operational Factors: The operations are related to the activities involved in supporting and implementing a smooth supply chain, mainly SCM practices such as inventory management and information technology to manage information flow

Case Study: The case-study approach definition adopted in this study is as stipulated by Green and Thorogood (2018) who defined a case study as an "*In-depth study undertaken of one particular 'case', which could be a site, individual or policy"* (Green & Thorogood, 2018).

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

The literature review chapter is divided into six sections. The first section explores the theoretical underpinnings of the study. In the second section, the pharmaceutical distribution chain in the public health sector in Kenya is presented. The third part discusses the factors affecting the pharmaceutical supply chain in Kenya and globally. In the fourth section, some ways of addressing pharmaceutical supply challenges through value stream mapping (VSM) and other strategies are discussed. The fifth part summarises the literature review, and the last part presents the conceptual framework for this study.

2.2 Theoretical Review

Today's SCM is complicated due to several actors and factors involved in outsourcing products and services (Sabbaghi & Sabbaghi, 2004). Several theories could be relied on to describe, explain and predict various aspects of supply chains, including organisational behaviours. The theories play a critical role in supply chain decision-making processes related to selecting partners, procurement, outsourcing, and resource and relationship management, among others (Fayezi & Zomorrodi, 2016). Despite the significance of theoretical foundations in improving the understanding of supply chains, no single theory fits all types of businesses (Halldorsson, Kotzab, Mikkola, & Skjøtt-Larsen, 2007), emphasising the importance of applying the most effective multiple lenses. Specifically, most of the available literature in the supply chain field have employed multiple theories to understand different dynamics of the supply chain and to communicate findings (Fayezi & Zomorrodi, 2016; Halldorsson et al., 2007; Sanderson, Lonsdale, Mannion, & Matharu, 2015; Swanson, Goel, Francisco, & Stock, 2017). Some of the most common and relevant SCM theories and models in the pharmaceutical industry include Lean management philosophy model, Transaction Cost Economics, Resource-Dependency Theory, and Network Theory.

2.2.1. Lean Models

Lean strategies are widely adopted to boost operational performance and proper financial resources management (Adebanjo, Laosirihongthong, & Samaranayake, 2016). According to (Dixit, Routroy, & Dubey, 2019), lean operations define an organisation's performance level by leading to operation change and general improvement in the quality of services. To establish the workability of lean operations in a supply chain, several lean methods could be applied (Henrique, Rentes, Godinho Filho, & Esposto, 2016; Wijewardana & Rupasinghe, 2016). The common ones include Lean Six Sigma and Value Stream Mapping (VSM). Others include Agility, Supply Chain Operations Reference (SCOR) model and Total Quality Management (TQM) (Chowdary & George, 2012).

2.2.1.1 Lean Six Sigma

The Lean Six Sigma management philosophy is perhaps one of the most relevant frameworks, combining a deliberate effort at identifying and minimizing waste to minimize systemic defects and ensure continuous quality improvement. In doing so, it combines the principles, tools, and methods of Lean (developed as part of the production system in Toyota) and Six Sigma (first developed at Motorola during the late 1980s) (Drohomeretski, Gouvea da Costa, Pinheiro de Lima, & Garbuio, 2014). These are summarised as the three key elements of Lean Six Sigma. They include process and methodology, tools and techniques, and mindset and culture. Process and methodology refer to a series of phases involving the use of problem-solving tools to identify root causes of problems and ensure that the proposed solutions are fully implemented (Pepper & Spedding, 2010). The problems are identified and solved through the use of various tools and techniques. Lastly, the element of mindset and culture refers to data and process-driven thinking to achieve the goals of operational performance and continuous improvement. These elements reinforce each other and have been proven to be effective in levels of the supply chain, particularly manufacturing (Raval & Kant, 2017). (Nwanya & Oko, 2019) noted that it is the incorporation of the data-driven six-sigma into a lean process that results in the elimination of defects.

Although there is growing evidence of the usefulness of Lean Six Sigma in various sectors, there is a lack of adequate research on its use in the healthcare supply chain (Cortes, Daaboul, Le Duigou, & Eynard, 2016). The few that have been conducted in this area have suggested that it could be useful. For example, a case study of a pharmaceutical company by (Rocha-Lona, Alvarez-Reyes, Eldridge, Garza-Reyes, & Kumar, 2013) showed that the application of Lean Six Sigma tools resulted in significant improvement of the distribution activity with reduced cycle times (26% reduction) and no customer complaints. (Argiyantari, Simatupang, & Basri, 2020) also noted that the pharmaceutical supply chain has undergone significant transformation by applying the lean principle. In particular, lean methods have led to reduced operational costs and improved overall efficiency, resulting in improved profits. This evidence suggests that the application of Lean Six Sigma in the pharmaceutical supply chain could influence both upstream and downstream activities as well as the entire supply chain process. Thus, the principle is worth exploring in this current research.

2.2.1.2 Value Stream Mapping (VSM)

The VSM is a concept that started in the Toyota car manufacturing company to evaluate its production system (Gunduz & Fahmi Naser, 2017). It is a useful tool in defining the steps in a process that contributes directly to the organisation's goal (Gellad & Day, 2016). It entails using flowcharts to help visualise the processes, actors, materials, and information movement across the value chain. This can help not only to identify wastes and reduce cycle times in a process but also to implement improvement strategies. This is particularly important in complex systems that involve numerous processes and activities like SCM. Therefore, VSM could play a critical role in large pharmaceutical distribution chains such as KEMSA.

As part of lean's objective, it aims to cut down on the non-value-add activities to improve production efficiency (Zahraee, Hashemi, Abdi, Shahpanah, & Rohani, 2014). Lean stakeholders can use VSM as a visual and process-based framework to note down, envisage, and understand information and material flow during a value stream process, with the main goal of recognising the underlying wastes and modalities for eliminating

them (Andreadis, Garza-Reyes, & Kumar, 2017). Organisations can visualise and streamline their VSM to reduce lead time, reduce non-value-adding activities (NVA), and increase production. Furthermore, the model can help in evaluating value-adding and non-value-adding actions to determine all the essentials of a product: the design process and flow of materials and information for a specific product line (Gunduz & Fahmi Naser, 2017) and the supply of the finished products to customers (Sheth, Deshpande, & Kardani, 2014). VSM can also help properly utilise human resources, space, and machines (Sheth et al., 2014). Thus, the lean thinkers emphasise its sustainability during the production process.

The SCM value stream arises from drawing the buyer-supplier relationship's capacity, skills, and strength. The upstream and downstream entities enabled through the SCM can either be direct or indirect; hence, organisations can accrue benefits by developing appropriate ties between suppliers and customers (Melnyk, Narasimhan, & DeCampos, 2014). These benefits are realised by lowering costs, having strategic focus, reducing inventories, and maintaining a high responsiveness level. Even though SCM's prominence continues to grow, transition suffices from a decoupled/price-driven supply chain strategy to a couple/value-driven strategy (Melnyk et al., 2014). Transition results from management-initiated actions sustained through corporate investment on strategies that can utilise resources well and enable marketplace competition.

Since VSM has a general methodology applicable in multidisciplinary fields such as management, engineering, and manufacturing (Sheth et al., 2014), it can be used within the healthcare environment to engage in ongoing improvements in an organisation for sustained competitiveness. Healthcare organisations can apply VSM when they want to understand their customers' needs and assess the customers' ability to pay for the products demanded. They can also evaluate value-adding and non-value-adding actions in their distribution processes. However, being a new concept in this area, more evidence to support its application is needed. For instance, VSM usage and the plan, do, check, and act (PDCA) approach can work for pharmaceutical firms (Qassim, Garza-Reyes, Lim, & Kumar, 2015). The 'plan' phase involves setting strategic goals and key performance indicators (KPIs) that can help an organisation reduce lead and changeover time, waste,

work-in-process (WIP), and the achievement of a continuous flow of materials. The 'do' phase involves assigning a VSM manager and a team to track the lean improvements (Fayezi & Zomorrodi, 2016). The 'check' phase entails assessing a current VSM and identifying non-value-adding activities and their root causes. The 'act' phase assesses the 'now' situation with the sole objective of envisioning and developing a value stream for the future. Finally, the 'act' phase requires a systematic approach, such as answering eight questions in Rother's (1999) proposed process. This evaluation could help address VSM limitations, such as the inability to yield immediate outcomes (Sheth et al., 2014). **Figure 1** represents a VSM that can be adopted for wastes classification during stationary and non-stationary productions.

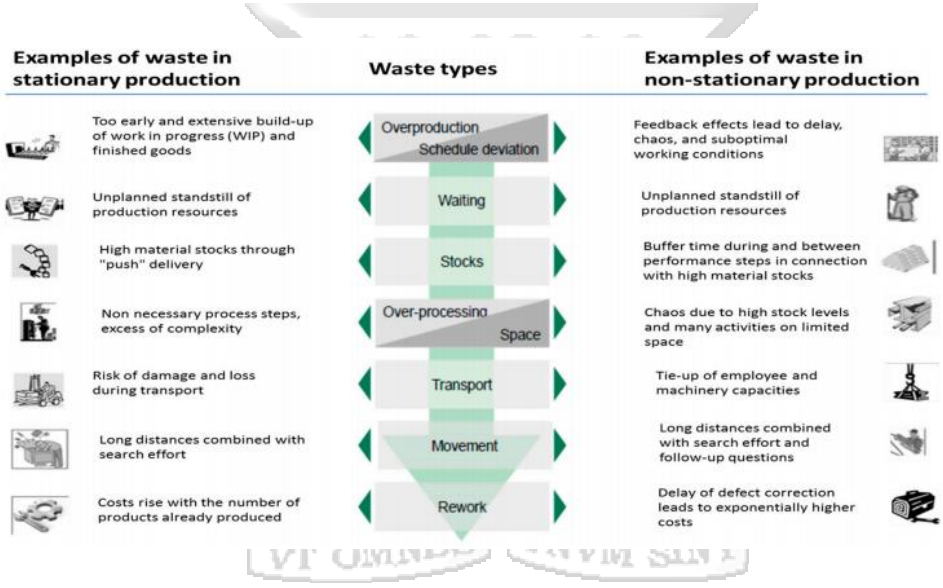

Figure 1: Waste classification schema in a VSM process (Gunduz & Fahmi Naser, 2017)

The application of VSM has both pros and cons. The method has proved deficient in efficient time management and comprehensive detailing of production processes, dynamics, and complexities (Nwanya & Oko, 2019). Scholars have come up with simulation models, such as ARENA, SIMUL8, Pro-MODEL, and WITNESS, among others to mimic an existing operating system to modify and incorporate them in lean manufacturing (Nwanya & Oko, 2019).

In the supply chain, the use of VSM results in productivity and cost advantages. A case study to validate the use of VSM showed an improvement in the total value-add time

(VAT) by 43% based on cycle time (Gunduz & Fahmi Naser, 2017). In contrast, non-value-add time was reduced by 27.8%. When the line of balance (LoB) was applied to the VSM, total lead time reduction went down by 30.7%, which also reduced the workforce by 12.5% (Gunduz & Fahmi Naser, 2017). Another research in a different discipline also affirms the effectiveness of VSM. Applying tools such as VSM and value stream design (VSD) proved helpful in reviewing logistical processes in a military organisation (Acero et al., 2020). However, variations in spare parts posed the main challenges in the phase of the project. The deployment of VSD indicated that a future state map had the potential of increasing value-added activities (44%-70%) and a further lead-time reduction from 69.6% to 61.9% (Acero et al., 2020). To undertake future activities, the authors recommend integrating different analytical tools to evaluate variations in the system. **Figure 2** shows ABC's VSM. The analytical process should include modelling and simulation before and after value stream analysis. It is essential to reinforce several practices, which can work towards yielding leanness.

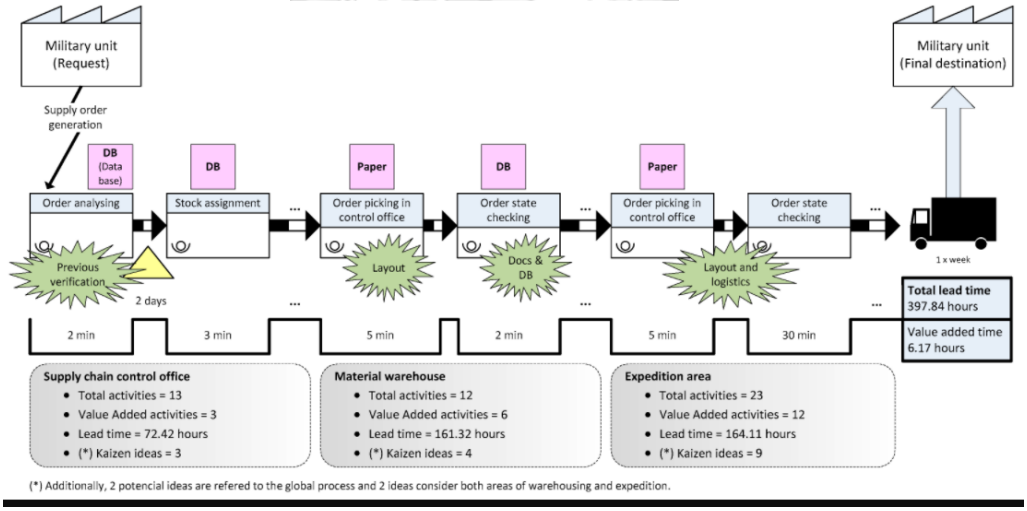

Figure 2: ABC's current state map for material ordering and processes and procedures – Source: (Acero et al., 2020).

The benefits of VSM for pharmaceutical firms have also been emphasised in research. A previous study established that using '5 whys' to identify manufacturing hurdles could identify the root cause of inefficiencies (Chowdary & George, 2012). Managers implemented lean principles to eliminate wastes and optimise total supply chain costs. A

VSM framework is pivotal in identifying types of processes to focus on and developing lean controls. Organisations should develop a holistic framework where leadership focuses on value, teamwork, mapping of procedures, and Kaizen undergoing continuous improvement to create value to customers in a supply chain (Machado, Scavarda, & Vaccaro, 2014). As such, firms can save on lost revenues incurred during reverse logistics and improve their supply chains' sustainability as a value stream.

2.2.2 Transaction Cost Economics Theory

Transaction cost economics (TCE) theory focuses on how balancing organisational structure and transaction costs can help achieve economic efficiency. The theory posits that efficiency in organisational governance structure can be optimised by minimising exchange costs (Williamson, 1979). In doing so, TCE aims to establish why firms are founded, how they are governed, and their hierarchical structure.

TCE theory argues that supply chain managers should consider the total costs, including transactional and hidden costs, when determining costs for buying or selling a product or service at any given time (Williamson, 2008). The hidden costs could be many and varied and may include coordination costs, such as time taken to develop the relationship and costs incurred in travelling and creating contracts when developing a relationship between a supplier and a customer. The hidden costs variability leads to uncertainties associated with transaction exposure and opportunistic behaviours (Fayezi & Zomorrodi, 2016; Slater & Spencer, 2000). To address this problem, a firm should account for all the costs related to production and transaction by analysing the transaction attributes, such as asset specificity and uncertainty, and making trade-offs in decision-making (Fayezi & Zomorrodi, 2016). The external environment is also a critical driver of TCE that influences coordination and transaction costs.

Supply chain firms should only outsource functions if the total cost is lower than the cost incurred in handling the functions internally (Williamson, 2008). A contract clearly defining each party's obligations and how the transactional costs are managed across the supply chain should be developed to manage buyer-supplier relationships. Another focus

of TCE is how minor players can exert considerable influence in the supply chain through structural manipulation (Fayezi & Zomorrodi, 2016). Overall, TCE influences decision-making processes to address market failures in the supply chain. However, its main shortcoming is that it fails to address human relationships among supply chain actors (Sanderson et al., 2015).

2.2.3 Ancillary Theories

2.2.3.1 Resource-Dependence Theory

Resource-dependence theory (RDT) could help explore the relationship between KEMSA and the Hospital at the analysis stage. The theory focuses on power relations based on the exchange of resources between organisations (Nienhüser, 2008). The theory posits that no company possesses all the resources they might require in the process of value-creation; thus, the interdependence between firms is essential. In these interdependent relationships, organisations can form strategic alliances or coalitions that promote the acquisition of resources and enable them to maximise their organisational power and resource dependence (Chiambaretto, 2015; Chicksand, Watson, Walker, Radnor, & Johnston, 2012; Nienhüser, 2008). These coalitions are often associated with highly variable and complex uncertainty; thus, organisations should determine how to manage these dependence relationships to maintain their functional and operational requirements (O'Keeffe, 2016). According to RDT, various strategies, such as resource manipulation and control exertion, could help manage the uncertainty and dependence on business transactions (Davis & Cobb, 2010; Nienhüser, 2008).

In the supply chain, the theory has been used to show the dissimilar nature of resource dependence in the traditional and best value supply chains (Ketchen Jr & Hult, 2007). In particular, the researchers showed that the traditional supply chains tend to use the power dependence opportunistically to provide them with an advantage over others along the chain. In contrast, best value supply chains use dependency to foster trust and commitment to fulfil the supply chain's requirements. Supply chain partners should depend on each other to gain higher performance rather than seeking personal benefits (Nienhüser, 2008).

2.2.3.2 Network Theory

Network theory defines the relationships between different organisations that could be both heterogeneous and homogenous in a particular network environment and examine why such networks are important (Ketchen Jr & Hult, 2007). It recognises that complicated business processes require organisations to form strategic networks or alliances in the form of ties, partnerships, and long-term relationships to enhance information flow and access to resources, markets, and technology.

In achieving these aims, NT promotes the analysis of dynamic components of a network, including actors, operations, and resources, and the influence of inter-organisational relationships on these factors (Parkhe, Wasserman, & Ralston, 2006). From a network resource perspective, NT helps develop a more realistic assessment of a firm's resources and their implications for business (Borgatti & Halgin, 2011; Tikkanen & Halinen, 2003). The theory also argues that factors such as access to and coordination of resources should be considered in promoting relationships between organisations in today's dynamic business environment.

Similarly, NT has a wide range of applications in the supply chain involving increasingly complex networks in various activities, including but not limited to the outsourcing of processes and resources. NT posits that organisations should align to network connections that allow them to blend strong and weak ties to maximise organisational performance (Fayezi & Zomorrodi, 2016). For example, firms can design their supply chains in a way that allows them to benefit from factors associated with strong ties to build reliability on one hand and create flexibility based on weak ties on the other. The network approach can also enhance the sharing of knowledge that promotes innovation in the supply chain. Overall, NT could help understand supply chain actors' behaviour and their influence on the supply chain based on principles of trust and long-term bilateral relationships.

2.2.4 Relevance of the Theories to the Study

These theories will inform different aspects of the study, from the development of the conceptual framework (section 2.4) to understanding the effect of different factors on the distribution value chain during analysis. The central argument at this point is that the performance of the pharmaceutical supply chain is influenced by the structures and operation of the supply chain, but that it is not completely possible to know how these factors, and their interaction, interplay in the chosen case, especially in the context of additional supply chain challenges resulting from the Covid-19 pandemic (KEMSA was involved in some governance-related media storm that may have changed certain aspects of the operations; similarly, external shocks to the health system have affected operations at healthcare facilities).

Lean will permit a detailed identification of wastes and inefficiencies in the distribution chain, allowing estimation of the magnitude of the problem by comparing the cycle times against industry best practice standards. The TCE theory will help in detailed interpretations of the pharmaceutical supply chain performance in relation to costs. For instance, certain hidden costs may explain why supply chain managers take decisions that appear inefficient. The RDT and NT theories will explain why certain relationships exist outside of the formal relationship between KEMSA and the recipient hospitals, including DSCH. The overall goal is to establish the gaps in the supply chain and identify appropriate theories (or a combination of theories) to guide the development of the alternative supply chain model for use in the pharmaceutical distribution chain. Rather than using a didactic approach of picking one theory to inform the inquiry, the study opted for a more inductive approach, where different theories are used in a complementary fashion to explain different aspects of the study, for instance, applying different lenses to understand reasons underlying the structure of the supply chain and meanings behind certain supply chain decisions. Researchers are allowed to combine theories to explain different aspects of a project, but advised to specify which of the three purposes the combination seeks to achieve: synthesis (where the combination generates on new theory); complementing (where the theories merely complement each other in explaining

phenomena); and contradicting (where the theories are combined to explain the contradiction and identify the most superior arguments) (Cairney, 2013)

2.3 Empirical Review

2.3.1 Pharmaceutical Distribution in Kenyan Public Health Sector

Understanding the supply chain's main features is essential in recommending solutions to the challenges faced in managing it and increasing performance. In Kenya, the push distribution system was used previously, in which KEMSA supplied commodities based on rough estimates. However, a pull system was adopted in 2006, allowing health facilities to forecast and quantify their needs based on historical usage (Yadav et al., 2014). At times KEMSA used a mixture of both systems of distribution; push for Rural Health Facilities (RHFs) and pull for urban hospitals (Vledder et al., 2015). The organisation gradually moved towards the pull model to supply products nationwide on requisitions made quarterly. The pull system adoption facilitates the quarterly supply of commodities with a rapid turnaround. Existing evidence indicates a positive association between pull strategies and enhanced firm performance (Ndung'u, 2017). The pull system is adequate in budgetary execution to meet customers' demands for products (Kibuchi, 2012).

The pull model's implementation required adequate ICT investment for easy data flow of critical health information and stock on-hand. The US Agency for International Development (USAID) collaborated and gave monetary assistance to KEMSA for the development of a local enterprise resource planning (ERP) system (Yadav et al., 2014). The logistics management at KEMSA was boosted by implementing the Logistics Management Information System (LMIS) (Yadav et al., 2014). Adopting a technology-based distribution system has made the pull system successful in the post-devolution era at KEMSA because of the ease of placing orders. Nonetheless, it is impractical to rule out stock-outs resulting from reasons beyond their mandate. Therefore, this research will also inquire into the successes and failures of the pull distribution system.

2.3.2 Factors Influencing Pharmaceutical Supply Chain in Kenya

Studies in supply chain operation have established various pharmaceutical SCM challenges such as inconsistency in data, fragmentation of the supply chain systems, and inefficient processes (Kritchanchai, 2014). The public health facilities at national and county levels significantly rely on KEMSA. However, these health care institutions report that KEMSA's supply chain is complex and diverse (Kariuki et al., 2015). These factors present significant challenges to those involved in procurement services coupled with the fact that they might have other responsibilities at work. For instance, medical staff and clinicians engaged in the procurement of pharmaceutical supplies might be required to make critical decisions regarding patients' supplies, placing orders to KEMSA and ensuring their availability in addition to responding to medical emergencies (Yadav et al., 2014). Also, they might be required to deal with NGOs, KEMSA, and private wholesalers, look for donations and respond to the needs of dissatisfied patients. The healthcare personnel can also be tasked by ensuring proper utilisation of funds, such as the Health Sector Services Fund (HSSF) and Facility Improvement Fund (FIF) and managing terms of credit and debits. This multitasking could affect the healthcare personnel's ability to care for patients and the performance of the pharmaceutical distribution chain from KEMSA to healthcare facilities.

The segmentation of KEMSA's pharmaceutical supply chain also affects the performance of the supply chain in Kenya. The current decentralisation of health functions implies that counties are free to source pharmaceutical supplies from other sources. This is likely to disrupt the supply chain due to a lack of information to plan future supplies by KEMSA. The role of local importers and manufacturers of pharmaceutical products could also affect the KEMSA's supply chain.

Furthermore, financial constraints might prevent hospitals from making orders for pharmaceutical products. The hospitals might also substitute the required medicine with cheaper ones or fail to offer the full range of desired treatment because relevant supplies are unavailable. As such, the supply chain demand may not be a true reflection of customers' needs. Other factors that might influence the direction of KEMSA's supply

chain are corruption allegations and CoG's proposal for the decentralisation of procurement so that counties can do direct sourcing for pharmaceutical products (Ayega, 2020; P. Wafula & Oketch, 2020).

2.3.3 Strategies for Improving Pharmaceutical Supply Chain

Healthcare system delivery can be improved through concerted efforts targeting various areas, including the supply chain. In this regard, pharmaceutical distributors may employ various operations management tools and techniques for improved efficiency. Some of these interventions are discussed below.

2.3.3.1 Agility

Agility, as a concept covered in SCM theory, also affect the pharmaceutical supply chain. It refers to flexibility, responsiveness, and quickness in managing daily operations in SCM (Li, Chung, Goldsby, & Holsapple, 2008). Agility's main objective is to assess employee development and work environment (Dixit et al., 2019). Real-time updates of information can be a source of leveraging the current operations to meet the market demands. A supply chain's agility can be built on four dimensions: speed, ease, predictability, and quality (Ngai, Chau, & Chan, 2011). Speed is the ability to note the routine and unprecedented demands and communicate them to the entire supply chain stakeholders at the right moment. The ease of noting any changes and adapting to them make organisations able to handle any fluctuations in demand and unexpected events. Firms should make this the norm so that customers and other partners in the supply chain can establish their reliability. Quality is the underlying measure of the usefulness of a product. The final delivery of products to customers and their utilisation at the end of the supply chain should create value (Attaran, 2020).

Agile operation offers responsiveness, a desirable critical feature in the health care supply chain. Several factors constitute a successful agile operation. These include organisational structure, employee flexibility, seamless interaction between workers and the management, and inclusion of patients and employee views when making decisions (Patri

& Suresh, 2017). Several methods can be used to measure the agility of operations; for example, supply chain operations reference (SCOR), total interpretive structural modelling, partial least square, and leagility (a combination of lean and agile operations) (Blome, Schoenherr, & Rexhausen, 2013; Ghatari, Mehralian, Zarenezhad, & Rasekh, 2013; Patri & Suresh, 2017; Rahimnia & Moghadasian, 2010).

In the pharmaceutical sector, the four dimensions of agility ensure supplies are of acceptable quality, arrive in time, and meet a health system's objectives. Risks involved from the manufacturing stage to final delivery become the challenge. (Kapoor et al., 2018). The demands of the modern markets keep escalating. Patients demand personalised care in different environments, which calls for supplies at reduced costs at the respective points of care. Pharmaceutical companies struggle to meet the demand variances without sacrificing security and speed. For example, when there is a drug launch in the market, the supply chain faces a host of drivers and constraints arising from a different set of objectives. Various stakeholders have different business objectives that compromise the supply chain's goals. The sector is heavily regulated, leading to an increase in mergers and acquisitions to enhance R&D (Vyas, Narayanan, & RAMANATHAN, 2012). The pharmaceutical industry's supply chain surge makes network planning for optimal performance challenging to achieve (Zahiri, Jula, & Tavakkoli-Moghaddam, 2018). In the wake of these challenges, the pharmaceutical supply chain should emphasise lean and agile operations, providing vital tangible and intangible outcomes.

2.3.3.2 Supply Chain Operations Reference Model (SCOR)

SCOR model can also help improve the performance of the pharmaceutical distribution chain in Kenya. SCOR is a management tool that was developed in 2004 by the Supply Chain Council, presently known as Association for Supply Chain Management (ASCM) to address, improve, and communicate SCM decisions within a company and with its suppliers and customers (Drohomeretski et al., 2014). The model describes and explains the business processes required along the entire supply chain to meet the customer's needs and these processes can be improved. As a framework, SCOR focuses on six processes of the supply chain: plan, source, make, deliver, return and enable. These processes describe

various activities in the supply chain, including those associated with; developing plans to operate the supply chain (Plan), ordering, delivering, receipt, and transfer of raw materials, products or services (Source), conversion of raw materials or content creation for services (Make), creation, maintenance, and fulfilment of customer orders (Deliver), reverse flow of goods (Return), and management of the supply chain (Enable) (Drohomeretski et al., 2014). The model has been shown to be effective in improving the supply chain performance across various industry areas by increasing efficiency (Pepper & Spedding, 2010; Raval & Kant, 2017). SCOR framework can also be used for performance measurement (Drohomeretski et al., 2014; Rocha-Lona et al., 2013); thus, it would be a crucial tool for investigating pharmaceutical supply chain performance in this study.

2.3.3.3 Proper Inventory Management

Inventory management directly affects efficiency in delivering products to customers (Dixit et al., 2019). Proper inventory management reduces costs (Stecca, Baffo, & Kaihara, 2016). Many inventory management models are designed to overcome SCM challenges, including the Markov chain model (Saedi, Kundakcioglu, & Henry, 2016). Other models include the demand forecasting algorithm, lot sizing model, multi-echelon, Holt's model, and multi-supplier inventory model (Perlman & Levner, 2014; Rachmania & Basri, 2013; Varghese, Rossetti, Pohl, Apras, & Marek, 2012; S.-P. Wang & Lee, 2013). Applying any of the models can result in the effective management of inventory for health care institutions.

2.3.3.4 Technology Use for Information Flow Management

The adoption of IT in pharmaceutical SCM has a broad scope. IT is essential in improving the performance and quality of service for organisations in the healthcare sector. Safety and security of data, improvement in efficiency, and adoption of electronic health records can be realised through IT-based solutions (Turan & Palvia, 2014). Implementing IT-related strategies depends on an organisation's functions and priorities set by its leadership (Dixit et al., 2019). Data surveys and the balanced scorecard are possibilities for adopting

IT-based approaches in the pharmaceutical supply chain (Bhattacherjee, Hikmet, Menachemi, Kayhan, & Brooks, 2010; Obeidat, 2015; Wu & Kuo, 2012).

Similarly, information systems (IS) have a significant impact on SCM. Planning, sourcing, and delivery across the ranges of operations require tactical organisational strategy. As a strategy, IS-enabled integration can enhance the financial performance for enhanced market competition (Daneshvar Kakhki & Gargeya, 2019). Integration and communication on different business issues improve the supply chain's visibility and robustness (Huo, Zhang, & Zhao, 2015; Topal & Sahin, 2018). This, however, comes with concerns like rigidity resulting from partners' activities that directly affect flexibility (Daneshvar Kakhki & Gargeya, 2019). Hence, IS-related investments may also contribute to further challenges by creating a barrier to forming a new relationship or quitting an existing one. Therefore, it is essential to develop flexible and modular components of ICT (Daneshvar Kakhki & Gargeya, 2019).

Information sharing can improve SCM processes' integration; however, privacy and security issues are concerns and challenges due to trust limitations (Z. Wang, Ye, & Tan, 2014). The organisational environment's performance depends on the management of formal and informal security issues (Sindhuja, 2014). The advent of the internet of things and its subsequent security challenges raises security issues beyond conventional security networks. To generate the value stream through IS in the SCM, a detailed evaluation of security issues, consequences of information leakage, and modalities for improving supply chain security should elicit critical management decisions.

Continuous development in technology, such as warehousing automation, augmented reality, 3D printing, and digital manufacturing, opens up new opportunities in the supply chain (Despeisse et al., 2017; Schniederjans, 2017). There are many SCM perspectives brought by new technologies to increase distribution processes and manufacturing flexibility. However, the technologies also disrupt relationships among partners. Thus, adopting new technologies is a new competitiveness tool when building upstream and downstream nodes in the supply chain (Cannella, Dominguez, Framinan, & Ponte, 2018).

The managerial implications of adopting new technologies, therefore, pose new areas of research in SCM.

It is critical to recognise the emerging trends encapsulated in the Supply Chain Management Review when exploring SCM. The evolving supply chains across the globe emanating from internal capabilities, external pressures, and advances in technology call for organisations to re-evaluate their networks for future restructuring (Zimmerman, Wang, See, & Jaruhar, 2019). The future of supply chains depends on the changing customer channels, emerging technologies, sharing economy, and focus on the supply chain's visibility. The emergence of new customer channels like shipping directly to customers (DTC) is a new possibility. At least 40% of brands sell products to customers directly. The DTC sales projection is $130 billion by 2025 (Zimmerman et al., 2019). Supply chains should develop new capabilities that can operate beyond their current margins.

2.3.3.5 Training and Skills Development for Supply Chain Personnel

Another antecedent of promoting the efficiency of the supply chain in the pharmaceutical industry is through educating consumers and employees for operational efficiency. In the healthcare environment, inadequate knowledge, skills, and low morale can compromise quality service delivery. Training and motivating customers are pivotal in improving health care at a reduced cost (Damali, Miller, Fredendall, Moore, & Dye, 2016). A functional supply chain should ensure that both patients and employees get training and participate in activities.

Training on counterfeit drugs, which is a significant challenge in the pharmaceutical supply chain, could improve service quality. Globally, counterfeit drugs constitute 10% of medical supplies, even though the percentage may increase to 25% in other countries (Wyld, 2008). The prevention of counterfeit drugs can reduce inefficiencies in the supply chain as it reduces pilferage and tracking. Automatic identification technologies and radio-frequency identification tagging are some of the technologies that can prevent disruption

in the supply chain of drugs (Fosso Wamba & Ngai, 2015; Papert, Rimpler, & Pflaum, 2016).

2.3.3.6 Managing the Cold Chain

To overcome some of the pharmaceutical supply chain challenges, it is vital to manage the cold chain. In pharmacy, a cold chain refers to a combination of procedures, records, activities, and equipment used in running the logistics of temperature-dependent medical supplies and drugs. In the United States, the European Union, and Canada, the concept of cold chain management is increasingly becoming popular. Moreover, developing countries such as India are improving cold chain management using modern technologies (Dixit et al., 2019). Critical roles of cold chain management include maintaining the cold chain to ensure vaccine potency. This can be achieved through training staff handling cold chain processes.

2.3.3.7 Risk and Waste Management

The pharmaceutical supply chain would function optimally with adequate management of risks for specific healthcare system outcomes. By adopting risk management measures, organisations can eradicate both clinical and non-clinical risks. One approach to risk management is the effectiveness of decisions made within the supply chain delivery systems. Several scopes may arise within a facility during risk mitigation and spread the same risk to other partners in the supply chain (Cagliano, Grimaldi, & Rafele, 2011).

Medical waste management poses significant concerns to scholars in the health care sector. Healthcare wastes can be classified into those generated during patients' treatment and drug losses from poor inventory management and poor demand forecast. The two categories all put the environment and public health at risk. Appropriate healthcare waste management models can help to reduce wastes at the point of generation. Waste management influences organisational performance. To overcome the losses, proper inventory management and forecasting through lean tools are necessary for the health care supply chain (Dixit et al., 2019).

2.3.3.8 Collaboration with Suppliers

Firms within the pharmaceutical sector will encounter inefficient deliveries if they do not collaborate, plan, and have sufficient capacity (Gupta & Ramesh, 2015). Therefore, collaborating with others in the supply chain is fundamental in overcoming challenges and improving the competitiveness of organisations. Making shared decisions and equitably distributing the benefits accruing from the satisfaction of customer needs can result in greater profitability. When firms collaborate, they can manage market instabilities and overcome the bullwhip effect (Holweg, Disney, Holmström, & Småros, 2005). Collaboration yields positive results for partners by building trust, reducing lead time, enhancing stock safety, and increasing profit margins and customer satisfaction (Moosivand, Ghatari, & Rasekh, 2019). Assessment and supplier prioritisation also create agility for firms in the pharmaceutical supply chain (Moosivand et al., 2019). Collaboration results in effective resource management, cost reduction, and information accuracy (Chung & Leung, 2005; Segerstedt, Olofsson, & Eriksson, 2010) Another significance of collaborating in the pharmaceutical supply chain is to overcome the hurdles of reversed logistics. The system used in forwarding logistics cannot be replicated in the reverse supply chain (Bravo & de Carvalho, 2013). The reverse system is asymmetrical, unlike the forward system; hence, the flow of information and materials from either end of the distribution channel varies. Thus by collaborating, firms overcome the asymmetries and improve efficiency and effectiveness when their systems are integrated (Bravo & de Carvalho, 2013).

2.3.3.9 Adopting a Sustainable Pharmaceutical Supply Chain

Another approach developed to help firms in the pharmaceutical sector improve their supply chain competencies is a multi-objective model. The model aims to improve the distribution channel based on the three pillars of sustainability: social, economic, and environmental (Zandieh, Janatyan, Alem-Tabriz, & Rabieh, 2018). Managers can make strategic and technical decisions to build capacity and improve the flow of drugs and medical supplies to local distribution centres. The multi-objective model is useful because

it minimises costs, reduces environmental pollution, and maximises society's welfare (Zandieh et al., 2018).

A new idea for the sustainability of the pharmaceutical supply chain is Pharma Industry 4.0. It is a sustainable value proposition to invoke personalised, agile, and smart strategies in SCM. It is fundamental to institute a sustainable pharmaceutical supply chain to meet future smart management and operation demands in the whole life cycle of pharmaceutical supplies (Ding, 2018). This can be done by overcoming internal and external inhibitors such as poor coordination of information flow, lack of employee training, managerial incapability, and failure to enforce regulations. Pharma Industry 4.0 can benefit the pharmaceutical supply chain by increasing the flexibility of patient-centred drug supply. It improves the effectiveness of communicating information across different partners in the supply chain. Other benefits of Pharma Industry 4.0 include proper medical waste management, reduced pollution, and enabling autonomous decision-making by managers in the supply chain.

2.3.3.10 Continuous Evaluation of the Supply Chain Management Performance

Globalisation created a challenging work environment to meet customers' demands with diverse cultural backgrounds, needs, and economic abilities (Matthews & Thakkar, 2012). The growth of firms in globalisation lies in designing capacities and proper SCM for sustenance and profit optimisation (Mattsson, 2003). Thus, the performance of an organisation is an ingredient for the identification of strategies for improvement. Some of the proposed models in this regard are the DEMATEL-modified analytic network, Analytic hierarchy process (AHP), statistical package for social sciences (SPSS), SCOR, and Bayesian network (Bhatti, Singh, & Singh, 2015; Lenin, 2014; Magak, 2014; Sharma & Pai, 2015; Supeekit, Somboonwiwat, & Kritchanchai, 2016). These performance measurement systems have weaknesses resulting from their one-dimensional focus. Therefore, firms in the healthcare supply chain must determine how to measure performance via a system that has been monitored and evaluated for success.

2.4 Literature Review Summary

Globalisation has brought many changes in the international marketplace that define the new trends and influence business activities. The supply chain is essential in the planning phase, and as such, it requires constant monitoring. Several SCM issues have been discussed in the preceding literature sections. These include risk management strategies, performance enhancement, agility, responsiveness, integration, and the quality of relationships in the supply chain. Smart supply chain managers play a pivotal role in building new relationships, handling people, and responding to contemporary issues (Harvey, Kiessling, & Akdeniz, 2014).

There are multiple SCM practices with a significant impact on the pharmaceutical industry. Generally, the global SCM emphasises VSM, information system management, capacity building, customer relationships, demand and supply management, and inventory management, among other practices. A review of KEMSA's supply chain is essential in meeting this study's aim and objectives. The review reveals that apart from the general SCM practices, there are unique needs for KEMSA to model an effective SCM practice. The decentralisation of medical services has brought additional strains on KEMSA's supply chain. It will be vital to investigate if the pull distribution model has helped KEMSA enhance its supply chain performance.

The customisation of county pharmaceutical supplies needs and performance standardisation along those demands will generate new value streams as elaborated in **Figure 1**. Through VSM, pharmaceuticals can identify improvement areas because the model has successfully proposed lean processes for multidisciplinary sectors. VSM can be modified for application depending on scenarios that confront organisations. KEMSA's distribution chain to DSDH could be improved by reducing lead time and NVAT.

2.5 Conceptual Framework

The study's conceptual framework proposes that the performance of a pharmaceutical supply chain is primarily influenced by the supply chain's operation, which influences the availability of affordable pharmaceutical commodities at a facility level. The operations

are related to the activities involved in supporting and/or implementing a smooth supply chain, mainly SCM practices such as inventory management, cold chain management, and information technology to manage information flow. Also, the operation is influenced by structure and people. Structural factors are related to the supply chain's design, considering the supply chain's efficiency, agility, and flexibility. This also includes how companies build relationships and collaborations with other stakeholders. Conversely, people refer to personnel, suppliers and other players in the supply chain, such as donors.

The conceptual framework further postulates that structural and human factors can impose inefficiencies in the supply chain, leading to drug shortages in hospitals. Consequently, adequately understanding both the structural and human factors through Value Stream Mapping is a prerequisite for elucidating the supply chain's challenges and strategies to streamline the supply chain for better performance.

Overall, the conceptual framework represents a summary of the three theories used in this study. These theories are tied down into the conceptual framework by highlighting the quintessential aims of each into the organisational structure, human factors that influence an organization's operations. For instance, while the Transaction Cost Economics Theory focuses on how a balance between organisational structure and transaction costs can help achieve economic efficiency (thus highlighting the structural factors within an organization – KEMSA or DSCH – that would influence the pharmaceutical distribution chain), the ancillary theories highlight the relationships between organisations which reflect the human factors that may affect their interactions and therefore the availability of pharmaceutical commodities in this case. The conceptual framework is presented in **Figure 3**.

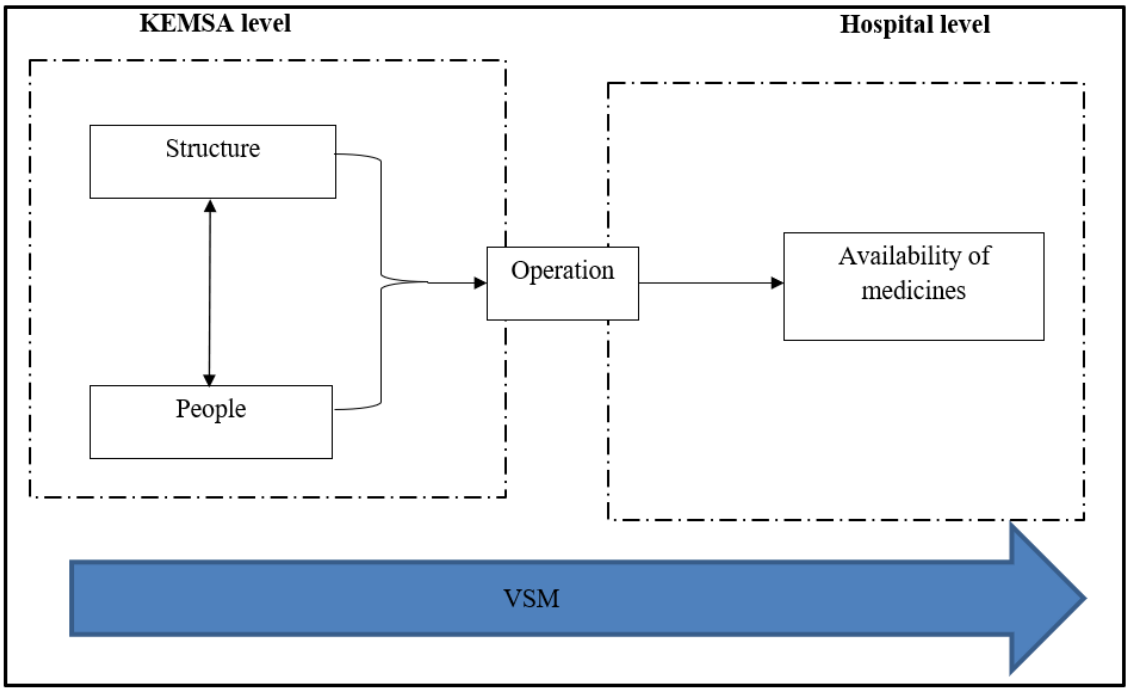

Figure 3: Conceptual framework

VT OMNES VNVM SINT

2.6 Operationalization of Variables

Table 1 highlights and describes the operationalization of the key variables used in this study. The table illustrates the operational definition of the study variables and how the variables will be measured.

Table 1: Operationalization of variables

Variable	Operational definition	Measurement indicator
Structural Factors	Factors related to the supply chain's design, considering the supply chain's efficiency, agility, and flexibility.	Demand forecasting Flexibility in procurement
Operations Factors	The operations are related to the activities involved in supporting and implementing a smooth supply chain, mainly SCM practices such as inventory management and information technology to manage information flow	Perfect fill rate Order Cycle Time
Human Factors	These are factors related to understanding the way workers behave, their capabilities and limitations.	Training frequency Error frequency
Availability of medicines	This refers to whether drugs were available within DSCH pharmacy.	Drug stock-out

CHAPTER THREE: METHODOLOGY

3.1 Introduction

This chapter describes the research design, study population, data collection tools, data collection, and data analysis.

3.2 Research Design

The research used a mixed-methods study design in collating and analysing data. The mixed-methods design employing quantitative and qualitative approaches was selected to help expand and strengthen the conclusions of the study. According to (Clark & Creswell, 2008), quantitative and qualitative data have different strengths, and integrating them helps overcome the limitations of one type. Thus, this study used the quantitative component to estimate distribution cycle times between KEMSA and DSCH. Additionally, a qualitative approach was used to explore and understand the distribution process and value of different processes, key performance determinants such as bottlenecks and defect causes, reasons for or not undertaking some steps, and how the distribution chain could be improved. Quantitative data was generated from archival information related to issues under investigation. The convergence of information from this mixed-methods approach informed the recommendations to enhance KEMSA's supply chain to public health facilities in Kenya.

3.3 Sampling

KEMSA was purposively selected because it is the primary public supply chain for Kenya. There are 4,882 public health facilities in Kenya, including three national referral hospitals, 320 county hospitals, and 4,556 primary care facilities (PharmAccess, 2016). This being a case study on a potentially sensitive area (supply chain matters are often secretive, with fear of reports of corruption where inefficiencies and inconsistencies are found), DSCH was selected, being the researcher's workstation and has built a relationship of trust with. Study participants at both KEMSA and DSCH were purposively selected to ensure that information was collected from persons most knowledgeable and involved in

supply chain matters. The case-study approach definition adopted in this study is as stipulated by Green and Thorogood (2018) who defined a case study as an "*In-depth study undertaken of one particular 'case', which could be a site, individual or policy"* (Green & Thorogood, 2018).

3.4 Data Collection Instruments

Data was collected following two sequential phases. The first phase involved two data collection instruments. First, an interview guide (combining open-ended and semi-structured questions) was used to gather qualitative data on the operations, processes, value-adding, and non-value-adding factors, all generating information needed to allow value-stream mapping. Two topic guides were used: one for KEMSA personnel and the other for DSCH management and staff. Second, a standard template was used to collect quantitative data related to activities undertaken by KEMSA in distributing supplies to the DSCH from the records.

The second phase involved validation of the developed value-stream map. In this phase, a validation guide was developed, based on previous interview data and analyses, to validate an alternative (ideal) distribution chain model with respondents across the two institutions. The guides were designed to match the different levels of expertise required to address supply chain management issues.

3.4 Validity

Concrete measures were taken to guarantee the validity of the study. First, the data collection instruments were piloted by sending a provisional interview topic guide to the staff at KEMSA and DSCH to gauge the interviewees' willingness to participate, ability to answer the questions, and schedule the interview. It was possible to know the questions that interviewees were unwilling to answer and amend them based on discussion with the supervisors before conducting the final interviews. Sending the interview guide in advance helped informants establish how this research project would help them improve their business processes. In addition, the standard template was carefully designed to inform the nature of data for extraction from the records.

3.5 Data Collection Procedures

The data was collected in three parts. The first part involved semi-structured interviews to understand the pharmaceutical supply chain issues and map the value stream. Interviews sought the personal experiences, views, opinions, and perceptions of key actors of the supply chain at KEMSA and DSCH about the operation and performance of the distribution chain. Semi-structured interviews were open-ended to enable the interviewees to give in-depth responses and encourage two-way communication. Document reviews followed this to triangulate information obtained from the interviews. Further interviews were conducted to validate the alternative pharmaceutical distribution chain model (Objective 3).

In the beginning, interviews targeted twelve personnel, including the Head of Procurement, Pharmacist-in-charge, Quality Assurance Manager, Warehouse Manager, Distribution Manager, and Finance staff who are directly involved in the SCM processes for KEMSA and DSCH. However, more participants were interviewed, depending on the information gathered and recommendations from those interviewed (snowballing). Interviews for validating the alternative pharmaceutical distribution chain model targeted the same respondents. Overall, the targeted interviewees were persons most directly involved in the planning, supervision, and operations of the selected pharmaceutical distribution chain.

3.5.1 Interviews

The researcher pre-scheduled the interviews to utilise time well and improve interviewee turnout. The interview guides were sent to the participants through emails before holding the interviews to help them prepare well for the sessions, give detailed responses, and have a snowball effect. During the interviews, the questions from the guide were followed. The researcher took notes of the variations in certain situations when an answer was given before asking a question contained in the guide. When that happened, the answered questions were passed in the interview guide. Probing questions were used in the interview

guide to allow the inquirer to seek further clarifications on a subject when unsolicited statements were made. Deep probing also helped separate facts from presumptions.

The interviews were scheduled to take the shortest time to enable the respondents to revert to their duties. The allocated time for each session was 40 minutes, and the first 5 minutes were dedicated to the introduction and explanation of the research purpose. Audiotaping was used to gather data after obtaining permission from the participants as it limits inaccuracies and inappropriate data articulation typical in note-taking (Ekanayake, 2011). The audio recordings were crucial in the later transcription and systematic analysis of the raw data.

3.5.2 Document Reviews

Quantitative data was gathered using a standard template guide. Retrieval of relevant quantitative data was done by targeting the KEMSA's supply chain processes to its customers across Kenya from the relevant records. Specifically, the data collection focussed on the components of KEMSA's value streams, including the value-add and non-value-add activities and the challenges faced by KEMSA in the distribution channels. The quantitative method of data gathering was expected to generate voluminous data within a short period for analysis.

3.6 Data Analysis

3.6.1 Qualitative Data

The audio-recorded interviews were transcribed verbatim. For maximum utilisation of the data, the researcher ensured the transcription was acceptable by typing all that was said. The interviewer also took note of the non-verbal communication false starts, grammar errors, and word repetitions. Capturing all non-verbal cues presented an accurate account of events as spoken by the interviewees.

All qualitative data were managed in NVIVO software and analysed using a thematic analysis approach. A thematic analysis approach was used for this study because it focuses

on “identifying, analysing, organizing, describing, and reporting themes found within a data set” and its flexible unlike other approaches such as grounded theory (Nowell, Norris, White, & Moules, 2017). Many advantages result from using NVIVO to improve research quality. The software makes qualitative data analysis more manageable than traditional methods and yields more professional results (Hilal & Alabri, 2013). A thematic analysis approach was used to analyse data. Key themes/topics were identified and analysed to draw patterns of meanings in the data.

3.6.2 Quantitative Data

Data from the standard template guide was analysed using STATA. STATA software manipulates and summarises data in social sciences for statistical analyses. The tool was used to run statistical formulae and manipulate the data gathered from the selected records to summarize the mean timelines between processes. The data analysis involved calculating the mean time taken between two processes/activities and presented in the current and ideal value-stream maps.

3.7 Ethical Considerations

Ethical approval was obtained from Strathmore University before conducting the study. Additionally, a research permit was obtained from NACOSTI. The researcher also explained the study’s purpose to the respondents and obtained written informed consent before collecting the data. Participation was voluntary, and participants’ identities were anonymised. Collected data were anonymised and kept in locked drawers.

CHAPTER FOUR: RESULTS

4.1 Introduction

This chapter details the study's findings, pooling evidence from both the qualitative interviews and the quantitative data abstraction from KEMSA and DSCH.

4.2 Sample Distribution

Overall, a total of 11 interviews out of 12 possible interviews were conducted. A majority of the interviewees, 81%, were male and had worked in the institutions for over three years. Additionally, the same respondents were presented with the 'ideal model' for validation.

Quantitative data were abstracted from the available fourteen pharmaceutical commodity orders both at KEMSA and DSCH.

4.3 Objective 1: Characterising KEMSA's Pharmaceutical Distribution Chain

4.3.1 The Mandate of KEMSA

The interviewees observed that the Kenya Medical Supplies Authority (KEMSA) had three broad mandates: i) procuring medical commodities, ii) warehousing the commodities, and iii) distributing them to public health facilities. As a result, the pharmaceutical distribution chain at KEMSA is characterised by the three key mandates with other roles described below.

> *"First thing you must know the mandate of KEMSA. The mandate of KEMSAstore, is procuring, warehousing, and distributing drugs and medical commodities and technologies to all public health institutions and beyond, that is the mandate."* KII 008 – KEMSA Warehouse Staff

> *"KEMSA's key mandate is to procure, warehouse and distribute, medicines and medical supplies, equipment."* KII 007 – KEMSA Warehouse Staff

"Ok I will summarise as per the KEMSA mandate. Procure, warehouse, distribute quality commodities." KII 005 – KEMSA Warehouse Staff

4.3.2 Pharmaceutical distribution chain process

The Managers interviewed at KEMSA described the pharmaceutical distribution process as having four major steps: i) identification of demand for commodities, ii) procurement, iii) warehousing and iv) distribution to customers (**Figure 4**).

4.3.2.1 Demand for pharmaceutical commodities

Through information gathered from the interviews, the pharmaceutical distribution process begins with an identified need for commodities within KEMSA. Demand for the commodities is identified either through one of these two ways:

a) **Customer-driven demand:** Participants at KEMSA and DSCH explained that this is where the customers (county public health facilities) lodge requests for pharmaceutical commodities based on their needs and urgency for these commodities. This is also in line with the change from a push system where KEMSA would send commodities to facilities based on what they had in store to a pull system where facilities request and get what they need.

"*So some of the procurement is informed by the counties, and that is why these days we have a lot of sales representatives who make inquiries on what particular hospitals or health facilities would want, and they make sure that maybe we avail them here."* KII 007 – KEMSA Warehouse Staff

"*We derive our demand and projections based on the registers we use. We fill them up to guide us on patient numbers and quantity of drugs every month."* KII 002 – DSCH staff

"According to me, always there is a request that comes from the user department, based on their needs. The know best what the need" KII 004 – DSCH staff

"Yes, like consumption data rate tool reports helps determine demand. Also devolution helped with consulting the ground and wanachi [citizens] *before supply. It played a big role. There it is partnership of County Government with KEMSA to get the demand.* KII 005 – KEMSA Warehouse Staff

Managers at DSCH, KEMSA and a Sub County Staff explained that the demand for commodities from a hospital to KEMSA goes through different stages until it reaches KEMSA. First, a hospital pharmacist logs in to the KEMSA's Logistics Management Information System (LMIS) and downloads the excel sales tool. They input the drugs they require upload them onto the LMIS and forward them to the sub-County Pharmacist who reviews and approves. After approval, the sub-County Pharmacist then forwards to the County Pharmacist, who approves, generates a Local Purchase Order (LPO) along with a proforma Invoice then forwards it to the County Offices for signing and approval.

"*We use LMIS. So, on LMIS you download the excel sales tool, input the drugs you require, upload onto LMIS then forward to the Sub County Pharmacist. Then they approve and then they forward to the County Pharmacist who approves then forwards to County Offices for approval."* KII 002 – DSCH staff

"After the County Pharmacist, The LPO has to be signed by three officers; Chief Officer of Finance, Procurement Officer, and a vote boss. That is where there are a lot of delays because of bureaucracies" KII 001 – Sub County Staff

"All our customers have visibility of what we have in the store at any given time through a system called Logistics Management Information System. That is where they make the orders" KII 00 – KEMSA Warehouse Staff

The quantitative data indicated that on average, it takes one month to fill up the excel tool kit and forward it to the County offices.

b) **KEMSA evaluation of potential demand for commodities:** Another Manager at KEMSA described the second method for determining the demand for commodities. KEMSA has a planning department that periodically evaluates the number and types of commodities demanded by customers over that period (often three months) and projects a similar demand for those commodities over another similar period (another three months).

"*At KEMSA we have the planning department they always evaluate customer demand and the availability of products, so maybe in the past three months if the customers demand a specific amount of certain product but it has not been reached maybe the order fill rate of that item has not been reached maybe if we want the order fill rate to be 80% of what the customers order but they have only achieved maybe 70% KEMSA will procure medical commodities to cover for the 10% or more."* KII 008 – KEMSA Warehouse staff

"However what we have in the store does not guarantee that the facility will receive. It depends on the Counties that have ordered. Maybe we have 100 items but we have 10 Counties that have ordered before you. The deficit will have to be planned for and filled when the commodities have been procured." KII 007 – KEMSA Warehouse staff

4.3.2.2 Procurement

Once the demand for pharmaceutical commodities has been identified, another Manager described the second step involving sourcing a supplier to deliver these commodities to KEMSA. This process is referred to as procurement. The procurement process can take one of the following three tendering approaches:

a) **Call down tenders** – This is where suppliers with a reputation to supply specific commodities at KEMSA are called to deliver those specific commodities based on the identified demand.

"*The tendering process in KEMSA is based on many factors; some always have like a maybe call downs a supplier already has a reputation of supplying efficient supply of certain items so they just get a call down tender maybe if that item is out of stock they will be given that tender to supply the specific item."* KII 008 – KEMSA Warehouse Staff

"Sometimes, they just call the predetermined supplier who usually supplies the commodity. In case there is an urgent need." KII 011 – KEMSA Warehouse Staff

b) **Direct procurement** – As described, direct procurement happens when a facility requires specific commodities in urgency and the commodities are available from only one supplier. This only happens when facilities require the pharmaceutical commodities urgently and are unavailable within KEMSA stores.

"*Direct procurement, maybe a specific facility requires a certain item, that item is maybe available at another pharmaceutical company like meds, there was a time, KEMSA at times buys the drugs from MEDS, mainly for maybe referral hospitals So in such a case where only, where a specific product is available from a specific supplier KEMSA will procure directly because of the urgency of the need."* KII 008 – KEMSA Warehouse Staff

"We do direct procurement for certain items. For example, lab reagents are not easily found through local suppliers. We have International suppliers who bring them" KII 006 – KEMSA Warehouse Staff

c) **Open tender** – As explained by the same Manager, the open tender involves the submission of bids from both local and international suppliers to bid for the supply of the specific pharmaceutical commodities in demand. These tenders follow the government procedures to tendering, where the tenders are advertised on KEMSA websites and advertised in newspapers. Companies submit their bids, a team evaluates the bids and selects the best supplier, often based on the lowest bid.

"Then other tenders are open national tenders or open international tenders where all suppliers … all willing suppliers from around the world are requested to table their tenders…… [then] *an evaluation team gets the best supplier for specific items"* KII 008 – KEMSA Warehouse Staff.

"Tenders are advertised in the newspapers then, of course, go through the official tendering process according to the Kenyan policies" KII 007 – KEMSA Warehouse Staff.

Once the supplier is identified for specific commodities, KEMSA signs a contract with the supplier and requires the commodities to be delivered within 12 weeks from signing the contract.

"*Once tenders have been awarded, the SOPs states that it should take about 3 Months to receive goods after contract signing"* KII 006 – KEMSA Warehouse Staff.

"This branding means that when you win a tender it will take a little longer to avail the products since the manufacturer will tailor make this product for KEMSA so this may cause some delays so maybe upon award maybe it can take like 3 months because you find that maybe for the manufacturer yours remains a special case there are other clients ahead of you so they finish their order then come to yours and your order being special will take longer so this is what makes it take 3 months to arrive at KEMSA." KII 009 – KEMSA Warehouse Staff.

4.3.2.3 Warehousing

Participants explained that once a supplier is selected and a contract is signed, the supplier is required to supply commodities within 12 weeks according to Standard Operating Procedures at KEMSA. Before submitting the final batch of the commodities, the supplier is required to provide a pre-delivery shipment to the quality assurance department for evaluation against required guidelines, including chemical analysis to evaluate whether

the commodity is fit for human consumption and physical requirements such as KEMSA markings. They also said that once the commodities are evaluated and pass the evaluation, the supplier is given an acceptance letter to liaise with the warehouse manager to schedule deliveries. The warehouse manager confirms the availability of space within the KEMSA stores and schedules delivery at one of the eight warehouses.

"*So once a supplier gets an order they sign the contract, the supplier must provide a sample to KEMSA, the sample is usually one box of the commodity to KEMSA for evaluation at our quality assurance department. So, the QA department evaluates that one box against the existing requirements or the certificate of analysis that the manufacturer provided, to check if it complies and is safe for human consumption."* KII 005 – KEMSA Warehouse staff.

"so once this is accepted, the supplier is given our acceptance letter saying 'After evaluation, the committee found that this item is acceptable for receipt, please liaise with the warehouse manager to schedule for deliveries'" KII 008 – KEMSA Warehouse staff.

"*So, it is upon the warehouse manager to check the available spaces and advise the supplier on the quantity to be delivered. So, it is the warehouse manager who schedules with the suppliers on what to deliver and what time to deliver, we might not have space today, but maybe in one week, this volume of items will be consumed within the next one week."* KII 006 – KEMSA Warehouse staff.

"Accepting everything at the same time will occupy space for nothing and maybe there is another item that I need urgently, whereby if you give me a stock that will last for six months it will occupy the space that I could have used for another item. So we have been booking in suppliers based on the volume that we have. Our stock Holding policies tell us that we should at least have six months' worth of stock before we do procurement. When an item reaches six months' worth of stock we start the procurement process. But we keep three months of stock in this warehouse and three months in the holding warehouse. Just for space control. KII 007 – KEMSA Warehouse staff

On delivery, the warehouse staff must confirm several things as alluded to by one Manager at KEMSA. First, they check that the deliveries conform to the requirements, such as having KEMSA markings around the packaging and other requirements stipulated in the purchase order/contract. Once the commodities conform to these requirements, they are entered into the Warehouse Management System (WMS), an inventory system that details what commodities have been received in the warehouse, their quantity, and other information such as the specific supplier of the commodities. Once commodities are in the warehouse, customers (counties/health facilities) can view all available commodities at KEMSA through the LMIS and order the commodities they need.

"Once we have received the products here, we must ensure that they are in the system (Warehouse Management System). Once they are in the system, our customers can view what is available in KEMSA; they use the logistics management information systems, LMIS." KII 008 – KEMSA Warehouse Staff.

4.3.2.4 Distribution

The Warehouse Manager described that facilities log in to the LMIS and request the pharmaceutical commodities they need once commodities are warehoused. These requests are received through the finance department at KEMSA that checks whether the county has no debt and is creditworthy to receive the requested pharmaceutical products. Once these check out, the finance department sends the order to a customer service department which assigns order codes that are then sent to the specific warehouse for processing. Order processing in the warehouse involves KEMSA warehouse officers picking the orders from the shelves, confirming the required quantities as stipulated in the orders according to the picking lists and delivery summary sheets.

The commodities picked within KEMSA warehouses are then delivered to facilities primarily using contracted logistics companies. Delivery of the commodities is scheduled to specific timelines.

"Once they make the order through finance, finance sends the order to our customer service department, so the customer service department places the orders through specific

order codes. The customer service department creates orders and sends them to the warehouse, so the warehouse deals with order processing. Order processing in the warehouse involves, we can only process orders of items that are available in the system and that is the importance of receiving these orders in the WMS. Once they are available they can easily be picked on the orders. [the orders] *are processed by our order processing team. Once they are processed, they are picked in the warehouse, the orders are picked."* KII 008 – KEMSA Warehouse Staff.

"For example, I have an MOU in the County that I need to do delivery within 21 days then it should be 21 days. So, within 21 days, I have received the order in the warehouse, I have picked, confirmed, and distributed. That is after the LPO has been approved. So, for example a distribution for Kitui County, its leaving here today, within 4 days the distribution should have been completed to each and every facility that was assigned to that lorry. We normally give an extension of 2 days for extreme areas or hard to reach areas. On the 7th day proof of delivery must be here. We try to manage the distribution timeline. For RHF its always 4 days for hospitals 2 days." KII 006 – KEMSA Warehouse staff.

"We outsource 98% [contracted private logistics providers]*, 1% are KEMSA trucks, 1% self-collection … But we follow up in case of complaints. After three months, we do a DDS post-distribution Surveillance and spot check of our services and rate our transporters"* KII 006 – KEMSA Warehouse staff.

The quantitative data abstracted indicated that it took, on average, three months from when KEMSA received an order to when the order was delivered at DSCH.

4.4 Objective 2: Value-add and non-value-add activities/processes in the Pharmaceutical Distribution Chain

4.4.1 Demand for pharmaceutical commodities

After analysis of data, there are several value-adding activities at the demand identification stage of the pharmaceutical distribution chain. First, KEMSA changed from a push to a pull system which adds value to the process. Facilities can now get what they need, which enhances efficiency, reduces chances of stockouts and expiration of commodities in stock when facilities get unneeded commodities. It also ensures that there is space in the warehouse for the commodities that are needed.

"...we are trying to manage because we are doing our procurement based on demand. Yes, but back when we were doing the push system, an item could stay here even up to five years without going out. That meant many expiries." KII 007 – KEMSA Warehouse staff

"Yeah because there is less wastage of Course, then people are receiving what the actually require in the hospital instead of just being pushed for drugs that maybe you don't even have need for those dawas." KII 002 – DSCH staff

Second, a planning department within KEMSA helps streamline stock management by adequately planning and projecting the likely need for commodities, thus ensuring that fast-moving commodities are always available within KEMSA stores. Lastly, information systems for counties/facilities to place requests for pharmaceutical products make it easier for orders to reach KEMSA. For instance, customers can use the Logistics Management Information System (LMIS) to view what is available within KEMSA and order.

On the other hand, the process of ordering for public facilities is lengthy and requires many approvals. For instance, the pharmacists at the facility must submit to a sub-county pharmacist who must submit to the county pharmacists for approval then submit to the County Finance offices for approval before it goes to KEMSA. This process can delay obtaining required commodities from KEMSA even when those commodities are available within KEMSA stores. The quantitative data abstracted indicated that it took

eight months [95% CI: 3-12] for an approved Local Purchase Order to reach the KEMSA Finance Department.

"Can you imagine we made orders for the first quarter, and we have not received any drugs? We are now doing another order for this quarter, and we do not know what will happen. The whole of this year, we have not received drugs." KII 001 – Sub County Staff

"After the County Pharmacist, The LPO has to be signed by three officers. The chief officer of Finance, Procurement Officer, and a vote boss. That is where there is a lot of delays because of bureaucracies" KII 001 – Sub County Staff

4.4.2 Procurement

First, the flexibility of the tendering approach adds value to the pharmaceutical distribution chain at KEMSA. Given that KEMSA can directly procure, especially for specialized commodities that are needed with urgency makes the availability of these commodities quick and more efficient. Second, the use of the guidelines to the tendering process also adds value in that it improves transparency, reduces chances of corruption, and standardizes the process of procurement. This bodes well with the legal requirement for the tendering process.

However, some participants said the tendering process is often long and paper-based. For instance, a supplier's advertisement time and selection takes one to 12 months, and paper-based signing of documents is required. Systems to move this process from paper-based to online systems would highly improve efficiency. Additionally, some commodities from international suppliers are delayed at the port due to taxation issues. Perhaps, the government should reconsider taxation of donated commodities and have these come into the country tax-free. For instance, medicines for people living with HIV that are donated could avoid delays in reaching KEMSA warehouses and facilities if they can be exempted from taxation at the port.

"*One thing that should be improved, we should minimize the use of Physical purchase orders, I think the purchase orders and deciding of the contract should be done online,*

and nobody or no third party should have access to the letters or the purchase orders between the suppliers and KEMSA. Currently, you find that a contract will pass through many hands at the government, thereby delaying several processes." KII 008 – KEMSA Warehouse Staff.

"I think, there are certain, the ones that should come to the country as tax free should be the ones that are given by the partners, donors they should come to the country tax free because they're there to save our people. But, the others I think they should be taxed." KII 005 – KEMSA Warehouse Staff

4.4.3 Warehousing

A critical value-adding activity in the warehousing of pharmaceutical commodities at KEMSA is the Warehouse Management System (WMS) that ensures that commodities are coded in, making it easy to understand where in the shelves these are stored and easy for retrieval. Linkage of this system to the LMIS makes it easier for counties/facilities to request commodities. Besides, the use of the WMS enhances overall efficiency within KEMSA's distribution chain. Besides, commodities are also assigned bar codes that facilitate storage, retrieval, and information entry into the WMS.

"At the point of receiving, we assign the barcode. So that barcode will facilitate everything." KII 011 – KEMSA Warehouse Staff

"I use LMIS; it helps us in interconnecting departments, helps in transportation and distribution and delivery services. It helps effective management and supply monitoring and also eased interconnection of logistics within KEMSA." KII 010 – KEMSA Quality Assurance staff.

Additionally, making it mandatory for suppliers to bring a sample of the pharmaceutical product for assessment and quality assurance is a value-adding activity. This guarantees the quality of commodities to be delivered and the safety of consumers.

"The suppliers bring a predelivery shipment so that the Inspection Control Committee analyze the consignment against the specifications on the tender." KII 006 – KEMSA Warehouse Staff

On the downside, there are only two distribution warehouses across the country, which contributes to delays in getting commodities to facilities. Coupled with inadequate logistic arrangements, this exacerbates delays in commodities reaching the warehouses and the clients. Another non-value-adding activity is that the commodities in the holding warehouses are not racked. They are stacked on the floor on top of each other. This causes delays when commodities have to be removed and transferred to the distribution warehouses

"Storage has been a major challenge. Some commodities may not have high demand as expected, as anticipated and this means it has to be kept longer than was initially expected, consuming space for other products that we have. We also do not store everything in this warehouse until maybe when a product is depleted and required, we ask for it from the other warehouse. The main constraint here is the process of getting the product here because sometimes the commodity is urgently required, and logistics may not be readily available. Sometimes the trucks are busy elsewhere, therefore, causing some delays." KII 007 – KEMSA Warehouse Staff.

"KEMSA has 8 depots around the Country but they are not distribution warehouses, they are holding warehouses. We only [have] *two distribution centers – Nairobi and Kisumu*" KII 006 – KEMSA Warehouse staff.

"Then also, in the holding warehouse, like these ones just across, items are not racked. Items are stacked on the floor, which consumes a lot of time. Those are some of the things we are trying to eliminate. We want to do purely racking, which will be easier for you to pull the items from the shelf to pick as opposed to going to offload from the stacks" " KII 009 – KEMSA Warehouse staff.

4.4.4 Distribution

The first value-add activity in the distribution is contracting out of the delivery trucks. This has been associated with improved efficiency and reduction of costs of delivery. Had KEMSA taken up this role fully, they would need more trucks, more staff, per diem for staff delivering commodities, fuelling of trucks, maintenance of trucks and other human resource management overheads that would increase the cost of the commodities.

Second, having well-integrated systems further facilitates the distribution of commodities. For instance, the commodities can be tracked using GPS; hence one can track where commodities are delivered or stored in case of theft.

Third, co-loading also helps to reduce transport costs. This happens by filling orders for the facilities in one truck route to enable a truck to carry as many orders from that County.

"And whenever we are issuing the orders sometimes we do it by County so that we can load if we have any other orders in that route just to minimize on the transport cost. Because we find we are running parallel programs. We have nutrition, malaria, HIV. So we always look at the schedule. For example, maybe Kakamega County just placed their order and there is any facility in that route we can co-load and we save on the issue of transport" KII 009 – KEMSA Warehouse staff.

"I use LMIS. It helps us in interconnecting departments. It helps in transportation and distribution, and delivery services. It helps effective management and supply monitoring and also eases the interconnection of logistics within KEMSA. It helps monitor transport even through GPS." KII 005 – KEMSA Warehouse staff.

On the downside, though, the non-value-adding activity occurs when KEMSA cannot fill the whole facility order. This occurs when some of the requested commodities are not available at KEMSA warehouses.

"So at any given time, we only service that particular order based on availability. But we always ensure that we have 75% of stocks in a particular facility. This being a government institution, sometimes we cannot do this always." KII 007 – KEMSA Warehouse staff.

"so maybe in the past three months if the customers demand a specific amount of certain product but it has not been reached maybe the order fill rate of that item has not been reached maybe if we want the order fill rate to be 80% of what the customers order but they have only achieved maybe 70% KEMSA will procure medical commodities to cover for the 10% or more." KII 008 – KEMSA Warehouse staff

4.4.5 Other value-add and non-value-add factors/processes

Several other activities within KEMSA add value to the distribution chain, whereas some do not.

a) **Training and capacity building of supply chain staff**

One Manager at Quality Assurance at KEMSA explained that the staff are trained periodically based on their needs to equip them with current knowledge that enables them to execute their roles efficiently. For instance, all staff state their training needs after every six months during performance appraisals, and these training needs are supported. Some employees have undergone training in inventory management which is associated with improvements in the execution of roles.

"KEMSA trains its employees periodically, I will be trained based on my needs another person will be trained based on his or her needs, every half a year the employees do appraisals. Under these appraisals, every employee indicates the kind of training that they need to undergo so that they become well conversant with their roles. For example, myself, I've undergone an inventory management system, understood how procurement relates to receipt of items or how they join or link with each other and other departments. The training s have helped many people to identify or improve in their roles and make everyone to be a leader in their sections, everyone is a leader, and we work in teams. Most people work in teams." KII 011 – KEMSA Warehouse Staff.

On the contrary, the participants at DSCH stated that they had not received any training on how to use LMIS and how to forecast and determine the demand for commodities for the next quarter.

"They should train everyone. We've never gotten training by KEMSA. Even us, even the Sub-county Pharmacist, the last time we got one I can't even remember. I think it was 2018. We are not capacity-built well. Yeah then the way they change the clients…. you know the way there is a lot of transfers. What if I am transferred, and someone else is brought in who doesn't know the process. A gap will be there. So it has to be a regular thing" KII 002 – DSCH staff

b) Collaboration between KEMSA and suppliers and counties

One Manager described that KEMSA has created a good network of suppliers and consumers (counties) with whom it collaborates to ensure that commodities are procured on time, warehoused, and delivered timely. For instance, KEMSA establishes some memorandum of understanding (MOUs) with counties and suppliers to ease business. Furthermore, these collaborations enhance the operational arrangements of KEMSA, which is key to ensuring the availability of commodities to the user (Figure 2.3).

"Then remember KEMSA, we are not independent. We depend on various partners like the Global Fund, USAID, WORLD BANK, etc. Yes people like UNICEF, they do their procurement but cost KEMSA to do warehouse and distribution. And remember, Donor Funded commodities are given for free. We just issue as per the donor requirements. They will give us a distribution list and tell us what to deliver where." KII 007 – KEMSA Warehouse Staff

c) Use of information technology

The use of technology is at the centre of KEMSA's operations as alluded to by the participants. Several platforms have been adopted to streamline service delivery, enhance inventory management and efficiency at the workplace. For instance, the use of LMIS, WMS, barcoding, and others have helped interconnect departments,

KEMSA, and counties and made the management of commodities more efficient. These technologies support the operation space (Figure 4), heavily contributing to the overall goal of making high-quality and affordable pharmaceutical products available to users.

"I think with the system in place have really helped. There are some places which didn't have the system. Now we have ERP, WMS warehouse management system, LMIS, IFMIS, FIFO, KAIZEN to determine whether something is adding value where it is. These systems have eased the work and eased the turnaround time on order processing and item delivery" KII 011 – KEMSA Warehouse Staff

"Once we have received the products here, we must ensure that they are in the system (Warehouse Management System). Once they are in the system, our customers can view what is available in KEMSA; they use the logistics management information systems, LMIS." KII 008 – KEMSA Warehouse Staff.

d) Flexibility in tendering

Flexibility is a quintessential component for enhancing the performance of systems. This study highlights the agility that KEMSA has employed in the tendering process where some commodities could be directly procured from suppliers based on the urgency and their availability

4.5 Objective 3: Current and alternative/ideal value stream map

4.5.1 Current pharmaceutical distribution chain

Figure 4 below presents the current pharmaceutical distribution chain involving KEMSA and DSCH.

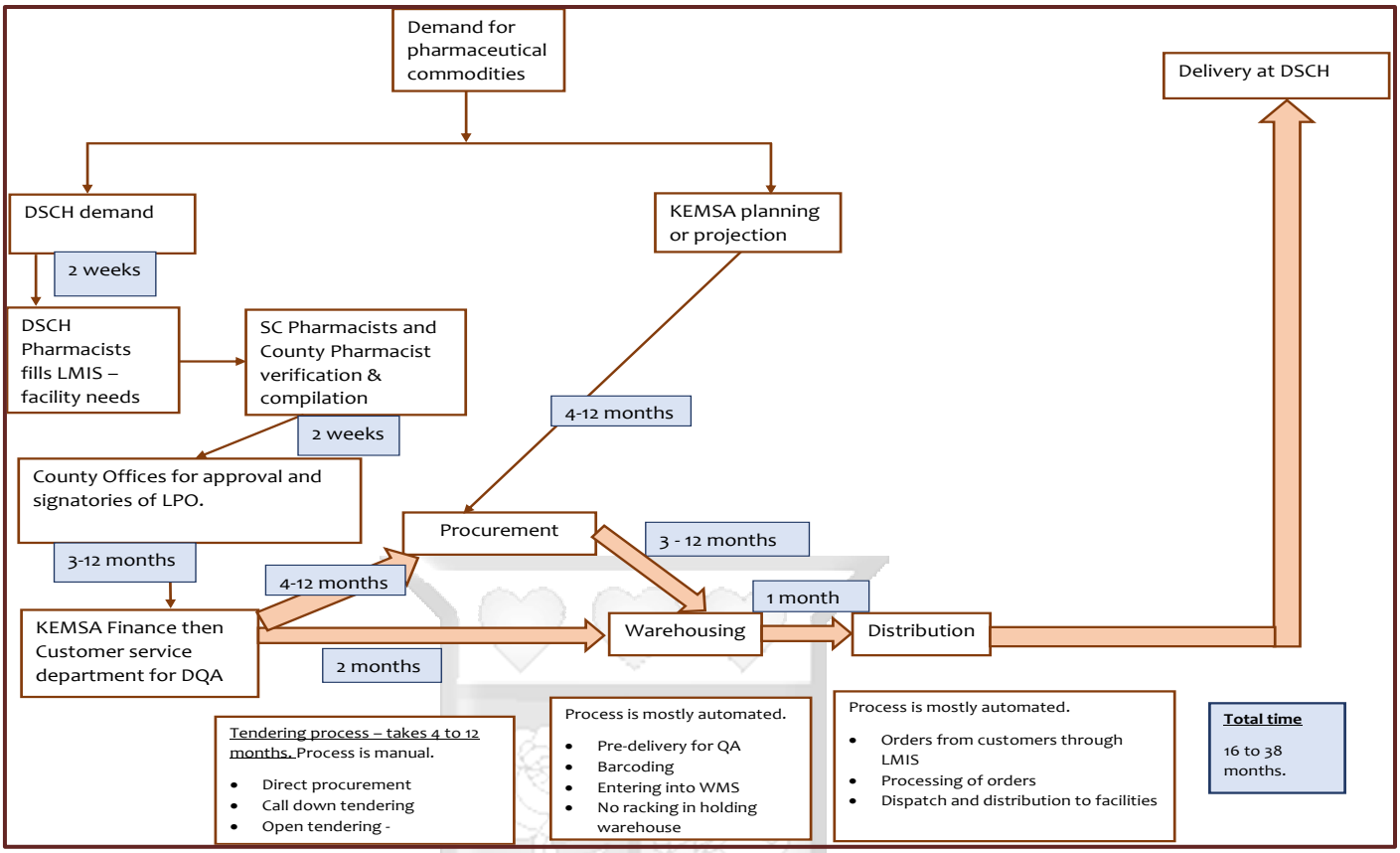

Figure 4: Current Pharmaceutical Distribution Chain

4.5.2 Ideal Pharmaceutical Distribution Chain

Figure 5 shows a modified version of the pharmaceutical distribution chain, adjusted to incorporate input from the interviews and validated through sharing with the interviewed actors and asking them to give their thoughts.

In the modified chain, the facility/DSCH, would directly purchase pharmaceutical commodities from KEMSA. This would reduce the delays resulting from having the hospital pharmacist submit requisitions to the sub-county pharmacist, who then submits to the county pharmacist for verification and approval before submitting to the County Offices. Moving to this ideal situation could cut down the cycle times by between 14 to 35 months, compared to the current process.

"So, the ideal for us is if they (the County) *were to give us money, then we do direct procurement from KEMSA. The County would give money then procure directly"* KII 003 – DSCH staff

"Before devolution, it was timely. It was every two months. The District Pharmacist then would receive and distribute on time. If we could avoid the County bureaucracy… if only it were possible. Getting the officers to sign and approve the LPOs to KEMSA can be so lengthy. There is a lot of bureaucracy which causes delay. Remember, back then, when it was National Government, it was very consistent. So what is happening right now is inconsistency. When they wake up and decide, they have money, they tell you to populate the tools and send them. We get a lot of expiries and we are not able to quantify it in a postdate manner. You quantify, but you don't know when it will come, so you order quantities you don't need. It was so much better when there was consistency. They just need to remove the process at the County. If they could just maintain the way they used to have a vote and an amount at KEMSA. It used to work. Here now as is, it depends if the County has money. If they don't they are not procuring. So now they are not procuring and no drugs in the facilities" KII 001 – Sub County Staff

"We have a challenge between counties and KEMSA. You know, where there is money, there comes a lot of conflicts. Some counties take the medicines on debt but pay cash to other suppliers and find it hard to pay KEMSA. Counties come with a lot of inadequacies in terms of payment" KII 009 – KEMSA Warehouse staff.

Another area where the ideal model adds value is at the procurement stage. The current manual procurement process takes approximately 4 to 12. The ideal model proposes automating the process, presenting two advantages. First, it would reduce the timeline for the procurement process to roughly one month. This would ensure that most of the items requested by the facilities are available to achieve a 75% or more fill rate. Second, the automation would reduce bureaucracies and corruption cases with the tendering process at KEMSA.

The ideal model adds value to the process by including regular training of staff at the health facility. The training of personnel at every stage of the supply chain would build

capacity and ensure effective and efficient supply chain. Most importantly, KEMSA would train the pharmacists and procurement officers on demand forecasting and how to use LMIS.

Lastly, the ideal model includes more distribution warehouses in each of the eight regions in Kenya instead of having only two in Nairobi and Kisumu. This is anticipated to reduce delays in distribution of commodities to facilities and the logistics costs incurred by KEMSA to distribute commodities. Consequently, this can bring down the cost of commodities to facilities.

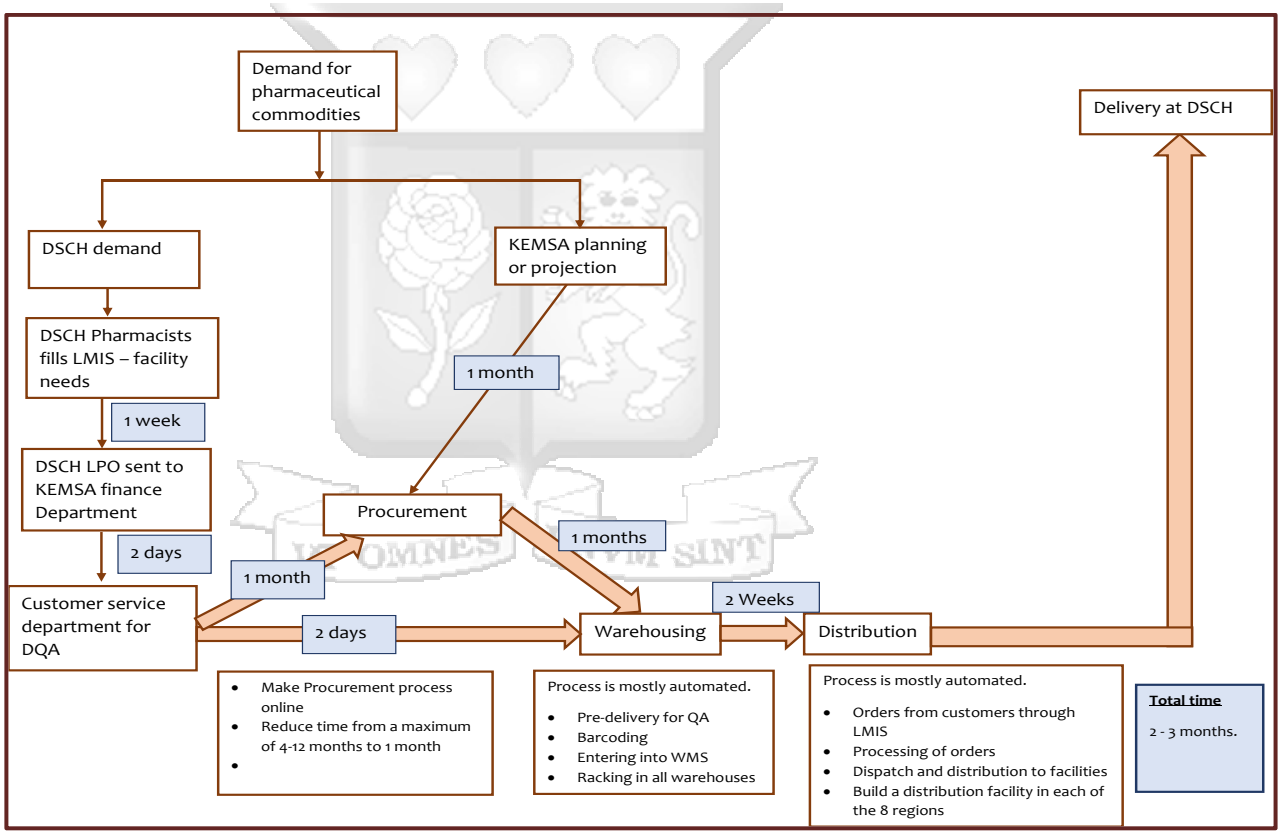

Figure 5: Validated Ideal Pharmaceutical Distribution Chain

CHAPTER FIVE: DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter attempts to explain the findings of this study in line with existing literature in Kenya and other settings. First, it summarizes the key findings of the research then discusses each of these. Overall, the study reports similar findings to those described in the literature review section, thereby validating the approaches adopted to answer the research questions of this study.

5.2 Summary of findings

This study aimed to characterize the pharmaceutical distribution chain, identify the value-add and non-value-add factors and map the current model and propose a more practical alternative model for improved supply chain performance. This study found that the current performance of the pharmaceutical distribution chain in the public sector in Kenya is well above average, with several value-adding factors that enhance its performance.

First, this supply chain was characterised by four key aspects including demand, procurement, warehousing and distribution of pharmaceutical products. The action of the aspects was further characterised by value-add processes such as the use of technology such as the LMIS, WMS, ERP, and others that improved efficiency and interconnectivity between KEMSA departments and the counties. Besides, KEMSA's operations were supported by qualified personnel who received periodic training in areas of their needs, which supported their overall career progression and the execution of their roles at the workplace. Additionally, this study highlights other value-adding factors such as agility in KEMSA's tendering process, good collaboration with counties, and outsourcing of

distributors of commodities. Furthermore, KEMSA's move from a push to a pull system has enhanced efficiency, reduced wastage of commodities, and generally the performance of the distribution chain. Now facilities can receive the commodities of their need rather than what are in the KEMSA stores.

Finally, incorporating the value stream mapping in this study enabled highlighting of the value-adding activities and the non-value-adding ones, which enabled the development of an ideal model. The validated ideal model suggests a reduction in the timelines of between 14 and 35 months which would enhance the performance of the distribution chain if adopted.

5.3 Discussion of the results

5.3.1 Characterization of the pharmaceutical distribution chain

The four key characteristics of the distribution chain were expected given that these define the key mandates of KEMSA as well as the activities taking place from the facility level (KEMSA, 2013). Further, the procurement process is highly monitored under the public procurement act in Kenya with a keen requirement for all procurement processes to align to the act (Amemba, Nyaboke, Osoro, & Mburu, 2013).

5.3.2 Value-add and non-value-add activities/processes

The use of technology to streamline processes at KEMSA is expected. Existing evidence from other settings has highlighted that the adoption of IT-based solutions has been associated with an improvement in efficiency (Turan & Palvia, 2014). Besides, information technology is an integral component of any modern supply chain management (Cachon & Fisher, 2000). Evidence on the role of IT in the distribution chain indicates that IT streamlines transactions, supports order tracking and processing, and enhances the distribution chain's planning and collaboration (Auramo et al., 2005). Within KEMSA, a recent study reported a strong association between the adoption of information technology and the operational performance at KEMSA (Michael, Fredrick, & O., 2018; Oduma &

Shale, 2019). It is not surprising that the ideal model would save more time with the procurement process.

Second, the adoption of capacity building through the training of staff is a critical strategy for improving the performance of pharmaceutical supply chains. Studies have shown an improvement in staff morale in executing roles after training (Khan, 2012). Besides, training has been used to nurture employees in their careers and introduce new systems for inventory management that enhance the performance of organisations (Wild, 2017).

Third, given the challenging conditions that inhibit adequate planning for optimal performance in the pharmaceutical industry (Zahiri et al., 2018), having agile systems is a prerequisite for achieving near maximum performance. KEMSA's agility in the tendering process conforms to this and validates the enhanced performance in its operations.

Fourth, the other value-adding factor, such as good collaboration with counties and suppliers, is no exception. There is a consensus of the importance of good collaborations built on trust for long term engagement in supply chain management (Sahay, 2003). These have been associated with generating positive behaviours among suppliers and consumers, lowering transaction costs, timeliness in delivering commodities, and other benefits. Besides, these are some of the strategies for improving the pharmaceutical supply chain discussed under section 2.3.3.

Fifth, our findings are in line with both the selected SCM theories from section 2.2 and the conceptual framework adopted for this study. For instance, the lean management philosophy model particularly VSM was quintessential in visualising the current processes adopted from DSCH to KEMSA. Evidence from the interviews, including the validation exercise, highlighted areas for improving performance (value-add time) especially the ordering of commodities from DSCH to KEMSA and the procurement process at KEMSA. This study further demonstrates the usefulness of VSM in the health sector especially in LMICs such as Kenya where its application remains low.

Finally, the VSM process highlighted the organisational structure both from DSCH and KEMSA and the capacity gaps at DSCH that influenced the facility and KEMSA

operations to either enhance performance or cause delays in the delivery of pharmaceutical commodities. For instance, respondents from KEMSA highlighted the availability of periodic training that equipped them with the knowledge to deliver on their tasks whereas, DSCH staff highlighted capacity gaps especially in using KEMSA information systems such as the logistics management information systems (LMIS).

5.3.3 Ideal/alternative model of the pharmaceutical distribution chain model

The employment of the VSM enabled the development of the alternative model validated across key stakeholders at KEMSA and DSCH. These findings are similar to those reported in other contexts in the health sector. For instance, Abideen et al., used the VSM approach to develop the current and future state warehouse supply chain in Malaysia thereby highlighting the time gained in moving to the ideal model from the current model (Abideen & Mohamad, 2020). Another recent study conducted in India on the role of supply chain VSM in government-supported drug distribution systems reported the ability to apply VSM in this sector (Dixit et al., 2021). Besides, these findings further reinforce the use of VSM in the health sector – an area it is currently growing traction (Sremcev et al., 2019) compared to other sectors such as the manufacturing sector (Sheth et al., 2014). Applying tools such as VSM and value stream design (VSD) proved helpful in reviewing logistical processes in a military organisation (Acero et al., 2020).

5.4 Study limitations

Findings from this study should be interpreted in light of the following limitation. Some respondents from finance departments at KEMSA could not participate in the study due to approval challenges, given that the study was taking part during a period where KEMSA was under scrutiny from suspected misappropriation of funds during the purchase of COVID-19 commodities. As a result, handy insights from this team may have been missed. Most importantly, the abstraction of quantitative data from procurement on the tendering processes and award of tenders to determine the cycle time from tender signing to delivery of consignment was not possible due to lack of permission from senior management, however, this information was obtained from the interviews.

5.5 Conclusion

Given the study's findings, the study makes the following conclusions. First, the pharmaceutical distribution chain in the public sector in Kenya is characterised by four key components: demand, procurement, warehousing, and distribution. Second, the study demonstrated several value-add factors, including the adoption of technology, training and capacity building of staff, adequate collaboration between KEMSA and other stakeholders, agility in tendering and adoption of the pull system as opposed to the push system. Non-value-add factors such as the lengthy bureaucratic processes at DSCH and procurement at KEMSA were highlighted. Consequently, it is imperative to consider these factors to sustain and further enhance the performance of the pharmaceutical distribution chain in the public sector. Particularly, activities that enhance the capacity of staff (people), the organization (structure), and the interconnectivity and technology (process) need to be taken into account if the performance of pharmaceutical distribution chains is to be sustained and enhanced. Finally, adapting the alternative pharmaceutical distribution model validated in this study would be beneficial given its time saving and reduction of bureaucratic processes both at KEMSA and DSCH.

VT OMNES VNVM SINT

5.6 Recommendations

This study makes some recommendations. First, The County Government of Nairobi should consider making Level 4 (Sub County Facilities) and above more autonomous by enabling them to make direct orders to KEMSA. This will make the process shorter in line with the ideal/alternative distribution model. A strategy to achieve this is to allow these facilities to make their budgets on pharmaceutical commodities and enable them to purchase by allocating them funds at the beginning of the calendar year. These Sub County facilities should ensure to have projections from their satellite facilities (i.e., dispensaries and health centres) before submitting the budget to the County.

Second, KEMSA should consider streamlining the procurement process to make it shorter and timelier. One such strategy to achieve this is to move from a paper-based system to an online procurement system where processes can be fast-tracked and areas for improvement easily identified. This would also enhance transparency and accountability within the distribution chain consequently, building trust with the citizens and suppliers. They should also regularly train health care workers working in Procurement and Pharmacy departments on how to use their systems like LMIS. This would ensure continuity of service and eliminate any gaps whenever staff are rotated or transferred.

Third, KEMSA should consider expanding distributing facilities to enhance efficiency and service delivery to its customers. Currently, only two of the eight warehousing facilities are used as distribution facilities serving the whole country. Besides adding new distributing facilities, KEMSA should also aim to equip existing facilities with updated state-of-the-art inventory management systems and systems to barcode and read barcodes to reduce human errors that sometimes lead to dispatching the wrong batch of commodities to facilities.

5.7 Suggestions for future studies

While this study critically characterises the pharmaceutical distribution chain in the public sector, there is a need to examine more than one facility across different counties especially where KEMSA does not currently have a distribution warehouse. This will aid proper comparisons and the development of a more representative value stream map for Kenya. Besides, given the share of private providers in Kenya, it may be important to also include the private sector in future studies to generate more holistic evidence representative of the whole health system rather than just in the public sector.

REFERENCES

Abideen, A., & Mohamad, F. B. (2020). Improving the performance of a Malaysian pharmaceutical warehouse supply chain by integrating value stream mapping and discrete event simulation. *Journal of Modelling in Management*.

Acero, R., Torralba, M., Pérez-Moya, R., & Pozo, J. A. (2020). Value stream analysis in military logistics: The improvement in order processing procedure. *Applied Sciences, 10*(1), 106.

Adebanjo, D., Laosirihongthong, T., & Samaranayake, P. (2016). Prioritizing lean supply chain management initiatives in healthcare service operations: a fuzzy AHP approach. *Production Planning & Control, 27*(12), 953-966.

Amemba, C. S., Nyaboke, P. G., Osoro, A., & Mburu, N. (2013). Challenges affecting public procurement performance process in Kenya. *International Journal of Research in Management, 3*(4), 41-55.

Andreadis, E., Garza-Reyes, J. A., & Kumar, V. (2017). Towards a conceptual framework for value stream mapping (VSM) implementation: an investigation of managerial factors. *International Journal of Production Research, 55*(23), 7073-7095.

Anne, M., & Juliana, N. (2019). Supply chain integration and operational performance of Kenya's public health sector. *International Journal of Research in Business and Social Science, 8*(5), 1-10.

Argiyantari, B., Simatupang, T. M., & Basri, M. H. (2020). Pharmaceutical supply chain transformation through application of the Lean principle: A literature review. *Journal of Industrial Engineering and Management, 13*(3), 475-494.

Attaran, M. (2020). *Digital technology enablers and their implications for supply chain management.* Paper presented at the Supply Chain Forum: An International Journal.

Auramo, J., Inkiläinen, A., Kauremaa, J., Kemppainen, K., Kärkkäinen, M., Laukkanen, S., . . . Tanskanen, K. (2005). *The roles of information technology in supply chain management.* Paper presented at the 17th Annual NOFOMA Conference.

Ayega, D. (Producer). (2020, August 17). Kenya: Governors Renew Calls to Procure Drugs Directly After KEMSA Scandal. Retrieved from https://allafrica.com/stories/202008200654.html

Bhattacherjee, A., Hikmet, N., Menachemi, N., Kayhan, V. O., & Brooks, R. G. (2010). The differential performance effects of healthcare information technology adoption. *EDPACS, 42*(4), 1-14.

Bhatti, S. K., Singh, R. P., & Singh, I. (2015). Analytical model for performance measurement in healthcare sector of Punjab. *Journal of Modelling in Management*.

Blome, C., Schoenherr, T., & Rexhausen, D. (2013). Antecedents and enablers of supply chain agility and its effect on performance: a dynamic capabilities perspective. *International Journal of Production Research, 51*(4), 1295-1318.

Borgatti, S. P., & Halgin, D. S. (2011). On network theory. *Organization science, 22*(5), 1168-1181.

Bravo, A. M. S., & de Carvalho, J. C. (2013). Understanding pharmaceutical sustainable supply chains–a case study application. *Independent Journal of Management & Production, 4*(1), 228-247.

Cachon, G. P., & Fisher, M. (2000). Supply chain inventory management and the value of shared information. *Management science, 46*(8), 1032-1048.

Cagliano, A. C., Grimaldi, S., & Rafele, C. (2011). A systemic methodology for risk management in healthcare sector. *Safety Science, 49*(5), 695-708.

Cairney, P. (2013). Standing on the shoulders of giants: how do we combine the insights of multiple theories in public policy studies? *Policy Studies Journal, 41*(1), 1-21.

Cameron, A., Ewen, M., Ross-Degnan, D., Ball, D., & Laing, R. (2009). Medicine prices, availability, and affordability in 36 developing and middle-income countries: a secondary analysis. *The Lancet, 373*(9659), 240-249.

Cannella, S., Dominguez, R., Framinan, J. M., & Ponte, B. (2018). Evolving trends in supply chain management: complexity, new technologies, and innovative methodological approaches. *Complexity, 2018*.

Cardinal, L. B. (2001). Technological innovation in the pharmaceutical industry: The use of organizational control in managing research and development. *Organization science, 12*(1), 19-36.

Chiambaretto, P. (2015). Resource dependence and power-balancing operations in alliances: The role of market redefinition strategies. *M@ n@ gement, 18*(3), 205-233.

Chicksand, D., Watson, G., Walker, H., Radnor, Z., & Johnston, R. (2012). Theoretical perspectives in purchasing and supply chain management: an analysis of the literature. *Supply Chain Management: An International Journal*.

Chowdary, B. V., & George, D. (2012). Improvement of manufacturing operations at a pharmaceutical company. *Journal of Manufacturing Technology Management*.

Chung, W., & Leung, S. (2005). Collaborative planning, forecasting and replenishment: a case study in copper clad laminate industry. *Production Planning & Control, 16*(6), 563-574.

Clark, V. L. P., & Creswell, J. W. (2008). *The mixed methods reader*: Sage.

Cortes, H., Daaboul, J., Le Duigou, J., & Eynard, B. (2016). Strategic lean management: integration of operational performance indicators for strategic lean management. *IFAC-PapersOnLine, 49*(12), 65-70.

Damali, U., Miller, J. L., Fredendall, L. D., Moore, D., & Dye, C. J. (2016). Co-creating value using customer training and education in a healthcare service design. *Journal of Operations Management, 47*, 80-97.

Daneshvar Kakhki, M., & Gargeya, V. B. (2019). Information systems for supply chain management: a systematic literature analysis. *International Journal of Production Research, 57*(15-16), 5318-5339.

Davis, G. F., & Cobb, J. A. (2010). Resource dependence theory: Past and future. *Stanford's organization theory renaissance, 1970–2000*.

Despeisse, M., Baumers, M., Brown, P., Charnley, F., Ford, S. J., Garmulewicz, A., . . . Reed-Tsochas, F. (2017). Unlocking value for a circular economy through 3D printing: A research agenda. *Technological Forecasting and Social Change, 115*, 75-84.

Ding, B. (2018). Pharma industry 4.0: Literature review and research opportunities in sustainable pharmaceutical supply chains. *Process Safety and Environmental Protection, 119*, 115-130.

Dixit, A., Routroy, S., & Dubey, S. K. (2019). A systematic literature review of healthcare supply chain and implications of future research. *International Journal of Pharmaceutical and Healthcare Marketing*.

Dixit, A., Routroy, S., & Dubey, S. K. (2021). Development of supply chain value stream map for government-supported drug distribution system. *International Journal of Quality & Reliability Management*.

Drohomeretski, E., Gouvea da Costa, S. E., Pinheiro de Lima, E., & Garbuio, P. A. d. R. (2014). Lean, Six Sigma and Lean Six Sigma: an analysis based on operations strategy. *International Journal of Production Research, 52*(3), 804-824.

Dwyer, K. (2011). *Is Supply Chain Management a Discipline? A Comparative Content Analysis of Academic and Practitioner Knowledge to Determine Disciplinary Identity*. University of Otago.

Ekanayake, A. (2011). Validity and Reliability in Case Study Research in Accounting: A Review and Experience.

Fayezi, S., & Zomorrodi, M. (2016). Supply chain management: developments, theories and models *Handbook of research on global supply chain management* (pp. 313-340): IGI Global.

Felea, M., & Albăstroiu, I. (2013). Defining the concept of supply chain management and its relevance to romanian academics and practitioners. *Amfiteatru Economic Journal, 15*(33), 74-88.

Fosso Wamba, S., & Ngai, E. W. (2015). Importance of issues related to RFID-enabled healthcare transformation projects: results from a Delphi study. *Production Planning & Control, 26*(1), 19-33.

Gellad, Z. F., & Day, T. E. (2016). What is value stream mapping, and how can it help my practice? *The American journal of gastroenterology, 111*(4), 447.

Ghatari, A. R., Mehralian, G., Zarenezhad, F., & Rasekh, H. R. (2013). Developing a model for agile supply: An empirical study from Iranian pharmaceutical supply chain. *Iranian journal of pharmaceutical research: IJPR, 12*(Suppl), 193.

Green, J., & Thorogood, N. (2018). *Qualitative methods for health research*: sage.

Gronauer, T., Scherrer-Rathje, M., & Friedli, T. (2009). A reference framework to sustainably implement operational excellence in the pharmaceutical industry.

Gunduz, M., & Fahmi Naser, A. (2017). Cost based value stream mapping as a sustainable construction tool for underground pipeline construction projects. *Sustainability, 9*(12), 2184.

Gupta, U., & Ramesh, A. (2015). Analyzing the barriers of health care supply chain in India: the contribution and interaction of factors. *Procedia-Social and Behavioral Sciences, 189*, 217-228.

Habib, M. (2010). Supply chain management: theory and its future perspectives. *International Journal of Business, Management and social sciences, 1*(1), 79-87.

Halldorsson, A., Kotzab, H., Mikkola, J. H., & Skjøtt-Larsen, T. (2007). Complementary theories to supply chain management. *Supply Chain Management: An International Journal*.

Harvey, M., Kiessling, T., & Akdeniz, L. (2014). The evolving role of supply chain managers in global channels of distribution and logistics systems. *International Journal of Physical Distribution & Logistics Management*.

Henrique, D. B., Rentes, A. F., Godinho Filho, M., & Esposto, K. F. (2016). A new value stream mapping approach for healthcare environments. *Production Planning & Control, 27*(1), 24-48.

Hilal, A. H., & Alabri, S. S. (2013). Using NVivo for data analysis in qualitative research. *International interdisciplinary journal of education, 2*(2), 181-186.

Holweg, M., Disney, S., Holmström, J., & Småros, J. (2005). Supply chain collaboration:: Making sense of the strategy continuum. *European management journal, 23*(2), 170-181.

Huo, B., Zhang, C., & Zhao, X. (2015). The effect of IT and relationship commitment on supply chain coordination: A contingency and configuration approach. *Information & Management, 52*(6), 728-740.

Ikundo, N. M. (2007). *Perceptions of pharmaceutical producers and end users towards the role played by pharmaceutical distributors using the value chain concept in Kenya.*

Kanyangi, F. (2018). *Distribution Strategies and Performance of Kenya Medical Supplies Authority.* University of Nairobi.

Kapoor, D., Vyas, R., & Dadarwal, D. (2018). An overview on pharmaceutical supply chain: a next step towards good manufacturing practice. *Drug Designing & Intellectual Properties International Journal, 1*(2), 49-54.

Kariuki, J., Njeru, M. K., Wamae, W., & Mackintosh, M. (2015). Local supply chains for medicines and medical supplies in Kenya: understanding the challenges.

Kazi, S. K. (2012). *Supply chain management practices and performance at Kenya medical supplies agency.* The University of Nairobi.

KEMSA. (2013). BUSINESS PRIORITIES. Retrieved from https://www.kemsa.co.ke/business-priorities/

KEMSA. (n.d.). About us: Welcome to Kenya Medical Supplies Authority (KEMSA). Retrieved from https://www.kemsa.co.ke/about-us/

Kenya, M. o. H. (2014). Kenya health policy 2014–2030: MoH Nairobi.

Ketchen Jr, D. J., & Hult, G. T. M. (2007). Bridging organization theory and supply chain management: The case of best value supply chains. *Journal of Operations Management, 25*(2), 573-580.

Khan, M. (2012). The impact of training and motivation on performance of employees. *Business review, 7*(2), 84-95.

Kibuchi, J. K. (2012). *Strategic planning practices by Kenya medical supplies agency.* University of Nairobi.

Kimathi, L. (2017). Challenges of the devolved health sector in Kenya: teething problems or systemic contradictions? *Africa Development, 42*(1), 55-77.

Kritchanchai, D. (2014). A framework for healthcare supply chain improvement in Thailand. *Operations and Supply Chain Management: An International Journal, 5*(2), 103-113.

Lenin, K. (2014). Measuring supply chain performance in the healthcare industry. *Science Journal of Business and Management, 2*(5), 136-142.

Li, X., Chung, C., Goldsby, T. J., & Holsapple, C. W. (2008). A unified model of supply chain agility: the work-design perspective. *The International Journal of Logistics Management*.

Machado, C. M., Scavarda, A., & Vaccaro, G. (2014). LEAN HEALTHCARE SUPPLY CHAI N MANAGEMENT: MINIMIZING WASTE AND COSTS. *Independent Journal of Management & Production, 5*(4), 1071-1088.

Magak, A. (2014). Effects of management of supply chain on performance of public health institutions in Migori County in Kenya. *Interdisciplinary journal of contemporary research in business, 5*(11), 82-104.

Matthews, L. C., & Thakkar, B. (2012). The impact of globalization on cross-cultural communication. *Globalization-education and management agendas*, 325-340.

Mattsson, L. G. (2003). Reorganization of distribution in globalization of markets: the dynamic context of supply chain management. *Supply Chain Management: An International Journal*.

Melnyk, S. A., Narasimhan, R., & DeCampos, H. A. (2014). Supply chain design: issues, challenges, frameworks and solutions: Taylor & Francis.

Michael, N., Fredrick, O., & O., A. J. (2018). Influence of Information Technology on Operations Performance of Public Health Facilities: A Case of Kenya Medical Supplies Authority.

Moosivand, A., Ghatari, A. R., & Rasekh, H. R. (2019). Supply Chain Challenges in Pharmaceutical Manufacturing Companies: Using Qualitative System Dynamics Methodology. *Iranian journal of pharmaceutical research: IJPR, 18*(2), 1103.

Muhia, J., Waithera, L., & Songole, R. (2017). Factors affecting the procurement of pharmaceutical drugs: a case study of Narok County referral hospital, Kenya. *Med Clin Rev, 3*(4), 20.

Ndung'u, K. P. (2017). *Effectiveness of push and pull marketing strategies in the sales and marketing of over the counter healthcare products by large pharmaceutical distributors in Nairobi*.

Network, S. D. S. (2018). Indicators and a monitoring framework: launching a data revolution for the sustainable development goals.

Ngai, E. W., Chau, D. C., & Chan, T. (2011). Information technology, operational, and management competencies for supply chain agility: Findings from case studies. *The Journal of Strategic Information Systems, 20*(3), 232-249.

Nienhüser, W. (2008). Resource dependence theory-How well does it explain behavior of organizations? *management revue*, 9-32.

Nowell, L. S., Norris, J. M., White, D. E., & Moules, N. J. (2017). Thematic analysis: Striving to meet the trustworthiness criteria. *International journal of qualitative methods, 16*(1), 1609406917733847.

Nwanya, S., & Oko, A. (2019). *The limitations and opportunities to use lean based continuous process management techniques in Nigerian manufacturing industries–a review*. Paper presented at the Journal of Physics: Conference Series.

O'Keeffe, P. (2016). Supply chain management strategies of agricultural corporations: A resource dependency approach. *Competition & Change, 20*(4), 255-274.

Obeidat, M. (2015). Examining the impact of information technology on supply chain management: An analysis of hospitals in Jordan. *International Journal of Economics, Commerce and Management, 3*(6), 72-96.

Oduma, R. O., & Shale, N. (2019). Effects of logistics automation on supply chain performance in Kenya Medical Supplies Authority. *International Journal of Social Sciences and Information Technology, 5*(4), 124-141.

Omboki, A. (2020, August 24). Corruption in purchase of Covid-19 PPEs is murder, WHO boss says. *Daily Nation*. Retrieved from https://nation.africa/kenya/news/corruption-in-purchase-of-covid-19-ppes-is-murder-who-boss-says-1923960

Ongarora, D., Karumbi, J., Minnaard, W., Abuga, K., Okungu, V., & Kibwage, I. (2019). Medicine prices, availability, and affordability in private health facilities in low-income settlements in Nairobi County, Kenya. *Pharmacy, 7*(2), 40.

Onyango, T. O. (2020). *Influence of technology on operational performance of pharmaceutical firms in Kenya.* Strathmore University.

Organisation, W. H. (2008). *Measuring medicine prices, availability, affordability and price components*. Retrieved from

Pablos-Mendez, A., Cavanaugh, K., & Ly, C. (2016). The new era of health goals: universal health coverage as a pathway to the Sustainable Development Goals. *Health Systems & Reform, 2*(1), 15-17.

Papert, M., Rimpler, P., & Pflaum, A. (2016). Enhancing supply chain visibility in a pharmaceutical supply chain. *International Journal of Physical Distribution & Logistics Management*.

Parkhe, A., Wasserman, S., & Ralston, D. A. (2006). New frontiers in network theory development. *Academy of Management Review, 31*(3), 560-568.

Patri, R., & Suresh, M. (2017). Modelling the enablers of agile performance in healthcare organization: A TISM approach. *Global Journal of Flexible Systems Management, 18*(3), 251-272.

Pepper, M. P., & Spedding, T. A. (2010). The evolution of lean Six Sigma. *The International Journal of Quality & Reliability Management, 27*(2), 138.

Perlman, Y., & Levner, I. (2014). Perishable inventory management in healthcare. *Journal of Service Science and Management, 2014*.

PharmAccess. (2016). A closer look at the healthcare system in Kenya. Retrieved from https://www.pharmaccess.org/wp-content/uploads/2018/01/The-healthcare-system-in-Kenya.pdf

Qassim, O., Garza-Reyes, J. A., Lim, M. K., & Kumar, V. (2015). *Integrating Value Stream Mapping and PDCA to improve the operations of a pharmaceutical organisation in Pakistan.* Paper presented at the Proceedings of the 23rd International Conference for Production Research (ICPR).

Rachmania, I. N., & Basri, M. H. (2013). Pharmaceutical inventory management issues in hospital supply chains. *Management, 3*(1), 1-5.

Rahimnia, F., & Moghadasian, M. (2010). Supply chain leagility in professional services: how to apply decoupling point concept in healthcare delivery system. *Supply Chain Management: An International Journal*.

Ramana, G. N. (2017). *Kenya-Health Sector Support: P074091-Implementation Status Results Report: Sequence 13*. Retrieved from

Raval, S. J., & Kant, R. (2017). Study on Lean Six Sigma frameworks: a critical literature review. *International Journal of Lean Six Sigma*.

Rocha-Lona, L., Alvarez-Reyes, S. E., Eldridge, S., Garza-Reyes, J. A., & Kumar, V. (2013). Lean six sigma supply chain case study: Aircraft shipment improvement in a pharmaceutical company *Advances in Sustainable and Competitive Manufacturing Systems* (pp. 1475-1487): Springer.

Sabbaghi, A., & Sabbaghi, N. (2004). Global supply-chain strategy and global competitiveness. *International Business & Economics Research Journal (IBER), 3*(7).

Saedi, S., Kundakcioglu, O. E., & Henry, A. C. (2016). Mitigating the impact of drug shortages for a healthcare facility: An inventory management approach. *European Journal of Operational Research, 251*(1), 107-123.

Sahay, B. S. (2003). Understanding trust in supply chain relationships. *Industrial Management & Data Systems*.

Sanderson, J., Lonsdale, C., Mannion, R., & Matharu, T. (2015). Towards a framework for enhancing procurement and supply chain management practice in the NHS: lessons for managers and clinicians from a synthesis of the theoretical and empirical literature.

Schniederjans, D. G. (2017). Adoption of 3D-printing technologies in manufacturing: A survey analysis. *International Journal of Production Economics, 183*, 287-298.

Segerstedt, A., Olofsson, T., & Eriksson, P. E. (2010). Improving construction supply chain collaboration and performance: a lean construction pilot project. *Supply Chain Management: An International Journal*.

Sharma, S., & Pai, S. S. (2015). Analysis of operating effectiveness of a cold chain model using Bayesian networks. *Business Process Management Journal*.

Sheth, P. P., Deshpande, V. A., & Kardani, H. R. (2014). Value stream mapping: a case study of automotive industry. *International Journal of Research in Engineering and Technology, 3*(1), 310-314.

Sindhuja, P. (2014). Impact of information security initiatives on supply chain performance. *Information Management & Computer Security*.

Slater, G., & Spencer, D. A. (2000). The uncertain foundations of transaction costs economics. *journal of Economic Issues, 34*(1), 61-87.

Sremcev, N., Stevanov, B., Lazarevic, M., Mandic, J., Tesic, Z., & Kuzmanovic, B. (2019). Improving process of quotation creation through value stream mapping and simulation. *Int. J. Simul. Model, 18*(4), 563-573.

Stecca, G., Baffo, I., & Kaihara, T. (2016). Design and operation of strategic inventory control system for drug delivery in healthcare industry. *IFAC-PapersOnLine, 49*(12), 904-909.

Supeekit, T., Somboonwiwat, T., & Kritchanchai, D. (2016). DEMATEL-modified ANP to evaluate internal hospital supply chain performance. *Computers & Industrial Engineering, 102*, 318-330.

Swanson, D., Goel, L., Francisco, K., & Stock, J. (2017). Applying theories from other disciplines to logistics and supply chain management: a systematic literature review. *Transportation Journal, 56*(3), 299-356.

Tikkanen, J., & Halinen, A. (2003). *Network approach to strategic management–exploration to the emerging perspective.* Paper presented at the Proceedings of the 19th IMP International Conference, Lugano, Switzerland.

Topal, B., & Sahin, H. (2018). The influence of information sharing in the supply chain process on business performance: An empirical study. *Stud. Inform. Control, 27*, 201-212.

Turan, A. H., & Palvia, P. C. (2014). Critical information technology issues in Turkish healthcare. *Information & Management, 51*(1), 57-68.

Varghese, V., Rossetti, M., Pohl, E., Apras, S., & Marek, D. (2012). Applying actual usage inventory management best practice in a health care supply chain. *International Journal of Supply Chain Management, 1*(2), 1-10.

Vledder, M., Friedman, J., Sjöblom, M., Brown, T., & Yadav, P. (2015). Optimal supply chain structure for distributing essential drugs in low income countries: results from a randomized experiment. *Ross School of Business Paper*(1269).

Vyas, V., Narayanan, K., & RAMANATHAN, A. (2012). Determinants of mergers and acquisitions in Indian pharmaceutical industry. *eurasian Journal of Business and economics, 5*(9), 79-102.

Wafula, F. N., Miriti, E. M., & Goodman, C. A. (2012). Examining characteristics, knowledge and regulatory practices of specialized drug shops in Sub-Saharan Africa: a systematic review of the literature. *BMC health services research, 12*(1), 223.

Wafula, P., & Oketch, A. (2020, July 16). Senior executives at Kemsa on EACC radar in graft probe. *Daily Nation*. Retrieved from https://nation.africa/kenya/news/senior-executives-at-kemsa-on-eacc-radar-in-graft-probe-1807596

Wang, S.-P., & Lee, W. (2013). A joint economic lot-sizing model for the hospital's supplier with capacitated warehouse constraint. *Journal of Industrial and Production Engineering, 30*(3), 202-210.

Wang, Z., Ye, F., & Tan, K. H. (2014). Effects of managerial ties and trust on supply chain information sharing and supplier opportunism. *International Journal of Production Research, 52*(23), 7046-7061.

Wasikea, D., & Mugambi, F. (2015). Effects of Pharmaceutical Procurement Processes on Performance of Public Health Facilities in Mombasa County, Kenya. *International Journal of Sciences: Basic and Applied Research, 24*(1), 245-272.

WHO. (2010a). *Monitoring the building blocks of health systems: a handbook of indicators and their measurement strategies*: World Health Organization.

WHO. (2010b). *The world health report: health systems financing: the path to universal coverage: executive summary*. Retrieved from

Wijewardana, A., & Rupasinghe, T. (2016). Lean healthcare framework for Sri Lankan healthcare supply chains: a case study of teaching hospitals. *Universal Journal of Management, 4*(10), 517-527.

Wild, T. (2017). *Best practice in inventory management*: Routledge.

Williamson, O. E. (1979). Transaction-cost economics: the governance of contractual relations. *The journal of Law and Economics, 22*(2), 233-261.

Williamson, O. E. (2008). Transaction cost economics *Handbook of new institutional economics* (pp. 41-65): Springer.

Wirtz, V. J., Hogerzeil, H. V., Gray, A. L., Bigdeli, M., de Joncheere, C. P., Ewen, M. A., . . . Mbindyo, R. M. (2017). Essential medicines for universal health coverage. *The Lancet, 389*(10067), 403-476.

Wisner, J. D., Tan, K.-C., & Leong, G. K. (2014). *Principles of supply chain management: A balanced approach*: Cengage Learning.

Wu, L., & Kuo, Y.-Z. (2012). A balanced scorecard approach in assessing IT value in healthcare sector: an empirical examination. *Journal of medical systems, 36*(6), 3583-3596.

Wyld, D. C. (2008). Genuine medicine? *competitiveness review: an international business journal*.

Yadav, P. (2015). Health product supply chains in developing countries: diagnosis of the root causes of underperformance and an agenda for reform. *Health Systems & Reform, 1*(2), 142-154.

Yadav, P., Institute, W. D., & Michigan, U. o. (2014). *Kenya Medical Supplies Authority (KEMSA): A case study of the on-going transition from an ungainly bureaucracy to a competitive and customer focused medical logistics organization*. Retrieved from http://documents1.worldbank.org/curated/en/876311468277741016/pdf/918640WP0P14870e0ongoing0Transition.pdf

Zahiri, B., Jula, P., & Tavakkoli-Moghaddam, R. (2018). Design of a pharmaceutical supply chain network under uncertainty considering perishability and substitutability of products. *Information Sciences, 423*, 257-283.

Zahraee, S. M., Hashemi, A., Abdi, A. A., Shahpanah, A., & Rohani, J. M. (2014). Lean manufacturing implementation through value stream mapping: A case study. *Jurnal Teknologi, 68*(3).

Zandieh, M., Janatyan, N., Alem-Tabriz, A., & Rabieh, M. (2018). Designing sustainable distribution network in pharmaceutical supply chain: a case study. *International Journal of Supply and Operations Management, 5*(2), 122-133.

Zimmerman, M., Wang, R., See, B., & Jaruhar, S. (2019). Four emerging supply chain trends for 2019. *Supply Chain Management Review*.

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Appendices

Appendix 1: Ethical Clearance Letter

Strathmore UNIVERSITY

10th September 2021

Dr Lelei Delyth,
delyth.lelei@strathmore.edu

Dear Dr Lelei,

RE: Strengthening Pharmaceutical Distribution Chains Through Value-Stream Mapping: A Case of The Kenya Medical Supplies Authority and Dagoretti Sub-County Hospital

This is to inform you that SU-IERC has reviewed and **approved** your above SU-master's research proposal. Your application reference number is **SU-IERC1061/21.** The approval period is **10th September 2021 to 9th September 2022.**

This approval is subject to compliance with the following requirements:

i. Only approved documents including (informed consents, study instruments, MTA) will be used
ii. All changes including (amendments, deviations, and violations) are submitted for review and approval by SU-IERC.
iii. Death and life-threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to SU-IERC within 48 hours of notification
iv. Any changes, anticipated or otherwise that may increase the risks or affected safety or welfare of study participants and others or affect the integrity of the research must be reported to SU-IERC within 48 hours
v. Clearance for export of biological specimens must be obtained from relevant institutions.
vi. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal.
vii. Submission of an executive summary report within 90 days upon completion of the study to SU-IERC.

Prior to commencing your study, you will be expected to obtain a research license from National Commission for Science, Technology, and Innovation (NACOSTI) https://research-portal.nacosti.go.ke/ and also obtain other clearances needed.

STRATHMORE UNIVERSITY INSTITUTIONAL ETHICS REVIEW COMMITTEE (SU-IERC)
10 Sep 2021
TEL: +254 (0)70303400
P.O BOX 59857-00200
NAIROBI-KENYA

Yours sincerely,

for: Dr Virginia Gichuru,
Secretary; SU-IERC

Cc: Prof Fred Were, Chairperson; SU-IERC

Ole Sangale Rd, Madaraka Estate. PO Box 59857-00200, Nairobi, Kenya. Tel +254 (0)703 034000
Email admissions@strathmore.edu www.strathmore.edu

Appendix 2: Research Permit from NACOSTI

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: 795382

Date of Issue: 21/September/2021

RESEARCH LICENSE

This is to Certify that Dr.. DELYTH CHEBET LELEI of Strathmore University, has been licensed to conduct research in Nairobi on the topic: STRENGTHENING PHARMACEUTICAL DISTRIBUTION CHAINS THROUGH VALUE-STREAM MAPPING: A CASE OF THE KENYA MEDICAL SUPPLIES AUTHORITY AND DAGORETTI SUB-COUNTY HOSPITAL for the period ending : 21/September/2022.

License No: NACOSTI/P/21/13020

795382

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

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THE SCIENCE, TECHNOLOGY AND INNOVATION ACT, 2013

The Grant of Research Licenses is Guided by the Science, Technology and Innovation (Research Licensing) Regulations, 2014

CONDITIONS

1. The License is valid for the proposed research, location and specified period
2. The License any rights thereunder are non-transferable
3. The Licensee shall inform the relevant County Director of Education, County Commissioner and County Governor before commencement of the research
4. Excavation, filming and collection of specimens are subject to further necessary clearence from relevant Government Agencies
5. The License does not give authority to tranfer research materials
6. NACOSTI may monitor and evaluate the licensed research project
7. The Licensee shall submit one hard copy and upload a soft copy of their final report (thesis) within one year of completion of the research
8. NACOSTI reserves the right to modify the conditions of the License including cancellation without prior notice

National Commission for Science, Technology and Innovation
off Waiyaki Way, Upper Kabete,
P. O. Box 30623, 00100 Nairobi, KENYA
Land line: 020 4007000, 020 2241349, 020 3310571, 020 8001077
Mobile: 0713 788 787 / 0735 404 245
E-mail: dg@nacosti.go.ke / registry@nacosti.go.ke
Website: www.nacosti.go.ke

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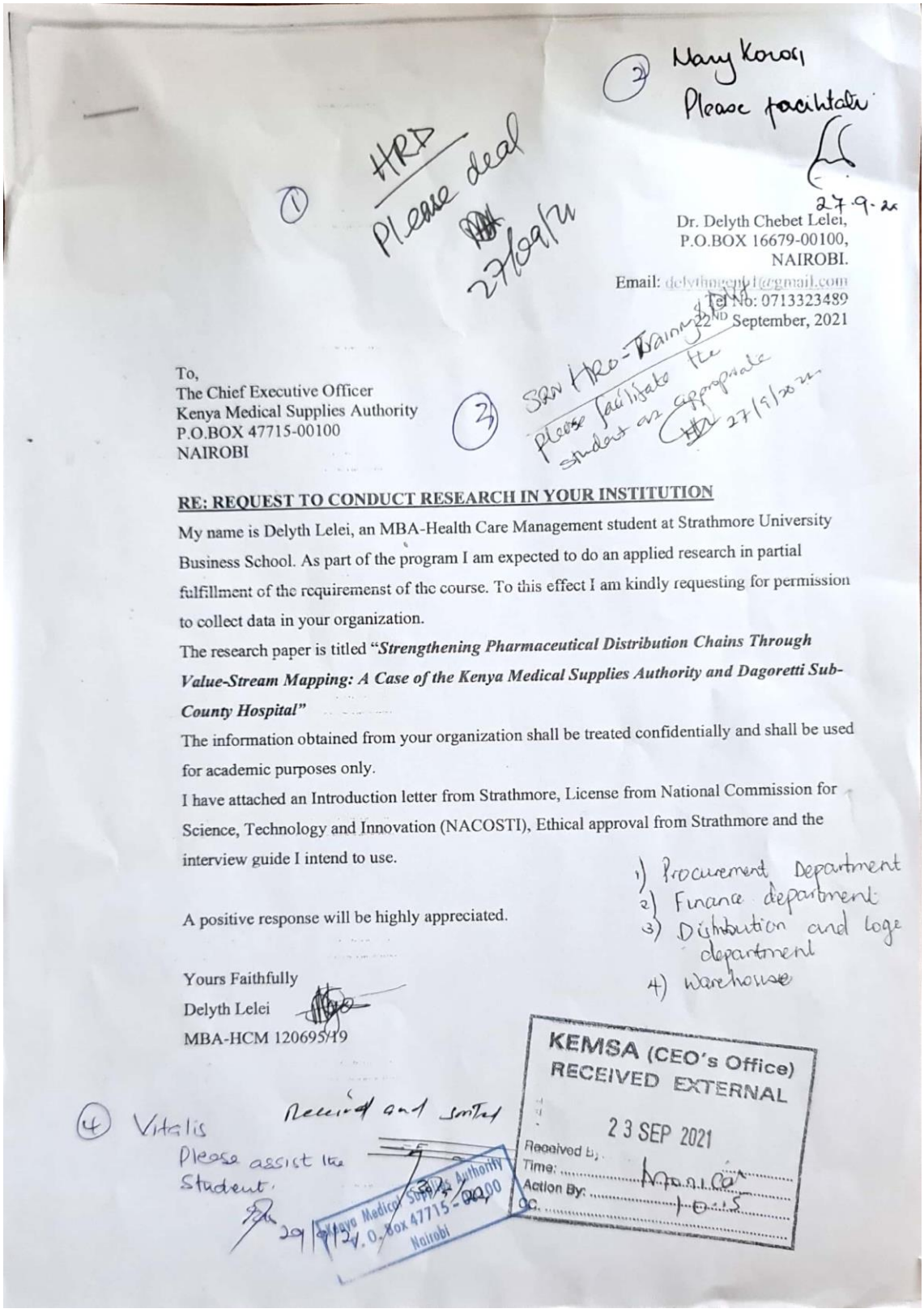
Appendix 3: KEMSA Consent to conduct interviews



(3) Mary Koros
Please facilitate
27.9.21

(1) HRD
Please deal
27/09/21

Dr. Delyth Chebet Lelei,
P.O.BOX 16679-00100,
NAIROBI.
Email: delythmgmt@gmail.com
Tel No: 0713323489

22ND September, 2021

(3) Saw HRO-Training
Please facilitate the student as appropriate
27/9/2021

To,
The Chief Executive Officer
Kenya Medical Supplies Authority
P.O.BOX 47715-00100
NAIROBI

RE: REQUEST TO CONDUCT RESEARCH IN YOUR INSTITUTION

My name is Delyth Lelei, an MBA-Health Care Management student at Strathmore University Business School. As part of the program I am expected to do an applied research in partial fulfillment of the requiremenst of the course. To this effect I am kindly requesting for permission to collect data in your organization.

The research paper is titled "***Strengthening Pharmaceutical Distribution Chains Through Value-Stream Mapping: A Case of the Kenya Medical Supplies Authority and Dagoretti Sub-County Hospital***"

The information obtained from your organization shall be treated confidentially and shall be used for academic purposes only.

I have attached an Introduction letter from Strathmore, License from National Commission for Science, Technology and Innovation (NACOSTI), Ethical approval from Strathmore and the interview guide I intend to use.

A positive response will be highly appreciated.

Yours Faithfully
Delyth Lelei
MBA-HCM 120695/19

1) Procurement Department
2) Finance department
3) Distribution and logs department
4) Warehouse

KEMSA (CEO's Office)
RECEIVED EXTERNAL
23 SEP 2021
Received By:
Time:
Action By:
CC:

(4) Vitalis
Please assist the Student.
Received and Stamped
29/9/21

Kenya Medical Supplies Authority
P. O. Box 47715 - 00100
Nairobi

Appendix 4: Letter of Introduction and Consent Form for interviews

Study Title: Strengthening Pharmaceutical Distribution Chains through Value-Stream Mapping: A Case of The Kenya Medical Supplies Authority and Dagoretti Sub-County Hospital.

Institution	**Student**
STRATHMORE UNIVERSITY BUSINESS SCHOOL	Delyth Lelei

Dear Respondent,

I am a Master of Business Administration in Healthcare management student at Strathmore University. As part of my academic requirements, I am carrying out a study that aims to evaluate the factors influencing the performance of Kenya's public health sector pharmaceutical distribution chain and identify opportunities for improvement. The box below tells you important things you should think about before deciding to join the study. We will provide more detailed information below the box. Please ask questions about any of the information before you decide to participate.

Key Information for You to Consider

- **Voluntary Consent**. You are being asked to volunteer for a research study. You can choose whether you participate or not. If you do agree you can change your mind at any time and withdraw from the research. This will not affect you now or in the future.
- **Purpose**. We are doing this research to understand the pharmaceutical distribution chain linking KEMSA to a public facility (Dagoretti Sub-County Hospital)
- **Duration.** Your participation in this study will take 0.5 to 1 hour.
- **Procedures and Activities.** We will ask you about your opinion on the pharmaceutical distribution chain with key consideration to its characteristics and value-add and non-value-add factors promoting or hindering efficiency in the distribution chain.
- **Risks or disadvantages.** The interview will take 0.5 to 1 hour.

- **Benefits**. There are no direct benefits in this study. However, in talking to me, you will contribute to knowledge about how the pharmaceutical distribution chain can be improved.
- **Alternatives.** Participation in this research is voluntary and you are free to choose to participate or not.

Why do you want to talk to me and what does it involve?

- You have been selected to participate in this study due to your role in this organisation (KEMSA/ Dagoreti Sub-County Hospital).

- The interview will be recorded to assist later in fully writing up the information. No one will be identified by name in the recording.

Are there any risks or disadvantages to me of taking part?

- The interview should take approximately half to one hour.

Are there any advantages to me of taking part?

There are no individual benefits to taking part. In talking to me, you will contribute to knowledge about how the pharmaceutical distribution chain can be improved.

Who will have access to the information I give?

- All of the documents/ recordings generated from this interview will be stored securely in locked cabinets and on password-protected computers. The knowledge gained from this research will be shared in summary form, without revealing individuals' identities.

Who has allowed this research to take place?

The research has been approved by the Strathmore Ethics Review committee who have looked carefully at the planned work. They must agree that the research is important, relevant to Kenya and follows nationally and internationally agreed research guidelines. This includes ensuring that all participants' safety and rights are respected.

What will happen if I refuse to participate?

All participation in research is voluntary. You are free to decide if you want to take part or not. If you do agree you can change your mind at any time without any consequences.

What if I have any questions?

You are free to ask me any question about this research. If you have any further questions about the study, you are free to contact the research team using the contacts below:

Delyth Lelei, Strathmore University Business School, **P.O. Box** 59857 – 00200, Nairobi, Kenya. Telephone: 0713 323489

I have had the study explained to me. I have understood all that has been read/explained and had my questions answered satisfactorily. And I agree to take part in this research

I agree for the interview/discussion to be recorded □ Yes □ No

I understand that I can change my mind at any stage and it will not affect me in any way.

Signature: _____ **Date** _____

Participant Name: _____ **Time:** _____

I have followed the study procedure to obtain consent from the participant. S/he apparently understood the nature and the purpose of the study and consents to participation in the study. S/he has been allowed to ask questions which have been answered satisfactorily.

Investigator's signature: _____Date _____

Investigator's name: _____Time _____

Appendix 5A: Interview Guide for KEMSA Staff (Supply Chain and Logistics Managers)

[Interviewer to introduce themselves and describe the objectives of the study]

IDI number	
Date of interview	

Department at KEMSA	
Gender of participant	
Start time	
End time	

1. What is your role at KEMSA?
2. How long have you worked in this role?

Objective 1: To describe the pharmaceutical distribution chain linking the Central medical stores (KEMSA) and use point (Dagoretti Sub-County Hospital)

3. Describe KEMSA's pharmaceutical distribution chain across the public sector in Kenya.
    a. How do you decide what commodities to buy and their volumes?
    b. What is involved in sourcing the commodities (including the timelines)
    c. What processes must be followed at KEMSA
4. What benefits has the transition from a push system to a pull system brought to KEMSA in its supply chain management? Would you recommend any changes moving forward?
5. Which other technologies, if any, have been supportive in developing the pull system?
6. What is it like to have Logistics Management Information System (LMIS) as a way of improving inventory management?
7. What role has capacity building played at KEMSA to make employees in the supply chain more effective?

Objective 2: To identify all non-value add steps/processes and activities throughout thr value chain.

8. How do pharmaceutical commodities get to KEMSA and to a public health facility in Kenya?
    a. What processes are involved for a supply to deliver pharmaceuticals to KEMSA?
    b. How long does it take to receive the pharmaceuticals from suppliers in KEMSA warehouses?
    c. What processes are involved before a county hospital receives supplies from KEMSA?
    d. How long does it take to supply pharmaceuticals to a county hospital in Nairobi?
    e. What role has technology played when KEMSA acquires or distributes its pharmaceuticals?
9. What activities add value or are crucial within KEMSA's distribution process? How are these activities value-adding?
10. What activities do not add value or are not crucial to the KEMSA's distribution process? How are these activities non-value adding?
11. What can be done to reduce or remove the non-value adding activities within KEMSA's distribution process?
12. What role has capacity building for staff played in strengthening KEMSA's distribution chain?

Challenges in the Distribution Chain for Pharmaceutical Products in Kenya

13. What challenges/barriers do you face in the supply chain management at KEMSA?

Summary and Concluding Remarks

14. What would be your ideal value streams for adoption to make KEMSA's supply chain?

15. What do you think I may have missed and you would like to add?

Appendix 5B: Interview Guide for Dagoretti Sub-County Hospital Staff

[Interviewer to introduce themselves and describe the objectives of the study]

IDI number	
Date of interview	
Department at KEMSA	
Gender of participant	
Start time	
End time	

1. What is your role at the hospital?
2. How long have you worked in this role?
3. What process is involved until you get pharmaceutical commodities from KEMSA?
4. What technologies do you use to place orders, receive consignments and make payments upon receipt of commodities from KEMSA?
5. What benefits has the transition from a push system to a pull system brought to this County Hospital's acquisition of pharmaceutical products from KEMSA?
6. Has KEMSA build the capacity of your employees in placing orders receiving consignments and making payments upon receipt of commodities from KEMSA?

Characterising the Challenges in the Distribution Chain for Pharmaceutical Products in Kenya

1. What challenges do you face with the KEMSA's distribution chain?
    a. placing and receiving medical supplies from KEMSA?
    b. Are there human resource challenges experienced by the hospital?
    c.

Topic 3: Summary and Concluding Remarks

1. What would be your ideal value streams for adoption to make the acquisition of pharmaceutical products from KEMSA more effective?
2. What can you add on the issues we have discussed today?

Appendix 6: Data Abstraction Template for Quantitative Research

SECTION A: IDENTIFICATION INFORMATION

Questions 1-2 should be filled by the survey enumerator him/herself. Section B onwards should be asked to the respondent.

	Name
1. Organisation (KEMSA or Hospital)	

2. Survey administrator information:
   2.1: Name of Interviewer: _____2.5. Interviewer Code ___/___/___/___/
   2.2: Signature of Interviewer: _____
   2.3: Name of Supervising Officer: _____ 2.6. Supervisor's code: ____/___/__/_____/
   2.4: Signature of Supervising Officer: _____

TIME STARTED:	**HOUR:**		**TIME ENDED:**	**HOUR:**
	MINUTES:			**MINUTES:**

SECTION B: MAIN QUESTIONS KEMSA

Question Number	**Question**	**Response**
1.	When was the most recent order placement date by Hospital (Dagoretti Sub-County Hospital)?	

2.	What is the order receipt date by KEMSA?	
3.	What date did KEMSA issue an invoice for the most recent order by the hospital?	
4.	When was the invoice sent and received by the Hospital?	
5.	How long (in days/months) did it take for the hospital to process the invoice?	
6.	What day was the invoice paid?	
7.	Which date did KEMSA start processing the order?	
8.	Which day did KEMSA complete processing the order?	
9.	Which software and technologies helped KEMSA to improve its supply chain effectiveness	

SECTION C: MAIN QUESTIONS HOSPITAL

Question Number	**Question**	**Response**
1.	When was the most recent order placement date by the Hospital (Dagoretti Sub-County Hospital) to KEMSA?	
2.	How was the order request delivered? (Soft Copy or Hard copy documents or Both)	
3.	When did the hospital receive the invoice from KEMSA?	
4.	How long (in days/months) did it take for the hospital to process the invoice?	
5.	What day was the invoice paid?	
6.	Which day did KEMSA complete processing the order (the day the hospital received the commodities)?	
7.	Which software and technologies helped the hospital to improve its supply chain effectiveness?	

Appendix 7: Interview Guide for KEMSA and Dagoretti Sub-County Hospital Staff to validate a model distribution chain

[Interviewer to introduce themselves and describe the objectives of the study]

IDI number	
Date of interview	
Department at KEMSA/Hospital	
Gender of participant	
Start time	
End time	

[The interviewer to present to the respondent what was identified in the first interview phase as ideal factors/ingredients of a pharmaceutical distribution chain]

From the previous interviews, we identified the following key factors (state the key factors) and we would like to know how best these can feasibly be implemented in your organisation.