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INFLUENCE OF INVENTORY MANAGEMENT PRACTICES ON THE AVAILABILITY OF EMERGENCY OBSTETRIC DRUGS IN RWANDA'S PUBLIC HOSPITALS: SOUTHERN PROVINCE OF RWANDA.

THESIS SUBMITTED TO THE UNIVERSITY OF RWANDA, IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTERS IN HEALTH SUPPLYCHAIN MANAGEMENT (MSc HSCM)

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STUDENT DECLARATION

I, **Kabera Jean Claude**, declare that the Thesis entitled *"**Influence of Inventory Management Practices on the Availability of Emergency Obstetric Drugs in Rwanda's public hospitals: Southern province of Rwanda***." is the production of my original work and has never been presented or submitted for a degree or professional ward to any other University or institution.

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This Thesis entitled "***Influence of Inventory Management Practices on the Availability of Emergency Obstetric Drugs in Rwanda's public hospitals: Southern province of Rwanda"*** has been submitted for review with our approval as University supervisors:

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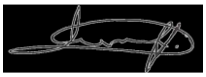

DEDICATION

My humble effort I dedicate to you, my sweet and loving,

Wife & Children

Whose affection, encouragement, love, and prays of day and night make me able to get such success.

ACKNOWLEDGEMENT

Given the encouragement, support and help got from many people, this is the time for recognition, you made this work possible; I send my gratitude.

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KABERA Jean Claude

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ABBREVIATIONS AND ACRONYMS

DH: District Hospital

E-LMIS: Electronic logistic management information system.

EmObc: Emergency obstetric care

EmOb: Emergency Obstetric

HCs: Health Commodities

HSCM: Health Supply Chain Management

LMICs: Low and Middle-Income Countries

MoH: Ministry of Health

MSH: Management Sciences for health

MCCH: Mother and Child Community Health

PPH: Postpartum hemorrhage

SCM: Supply Chain management

SDGs: Sustainable Development Goal

SPSS: Statistical Package for Social Sciences

UNCoLSC: United Nations Commission on Life Saving Commodities for Women and Children

WHO: World Health Organization

ABSTRACT

Stockouts of some life-saving drugs, such as emergency obstetric drugs, are evident in many health facilities and have been the leading cause of maternal mortality and morbidity for women in the developing world. In many cases, this situation is associated with poor inventory management practices. This study aims to provide adequate information to public health facilities in Rwanda that can be used to improve emergency obstetric care through proper pharmaceutical inventory management.

A survey was carried out in ten district hospitals of Rwanda. Quantitative data generated from the questionnaires and checklist were validated and fed into STATA13. Bivariate and logistic regression analyses were appropriately used.

The study revealed that keeping logistics management tools up to date is the backbone of inventory management practices in managing medicines and medical supplies. The results showed that hospitals with up-to-date logistics tools for their pharmaceutical management were 33.25 times more likely to have their emergency obstetric drugs in Stock than those that do not regularly update their logistics tools. The proper use of bin cards and electronic software (e-LMIS) contributed significantly to reducing the stockout rate of emergency obstetric drugs (88.9%). In addition, the use of simple techniques such as the Min-Max inventory control model (70%) and the Determination of quantities to order using past consumption pattern formulas has reduced the ratio of unusable to usable Stock by 79%. Over 18 months, oxytocin had the lowest average days (8) of stockouts at 1.5%. At the same time, magnesium sulfate injection experienced the highest Stock out, ranging between 16 days (2.96%) and 96 days (17.7%)and 367 days of overstocking at 67%, followed by Misoprostol. In health facilities, adequate supply chain staffing is essential to improving inventory management practices and medicine availability.

Proper pharmaceutical inventory management practices within hospitals premises positively influence the availability of life-saving drugs, such as emergency obstetric drugs.

Key Words: Inventory management, emergency obstetric drugs, logistic management tools, availability, public hospitals in Rwanda.

CHAPTER ONE: GENERAL INTRODUCTION

1.1 Background to the study

Mortality and morbidity, commonly associated with diseases, can be significantly reduced when medicines are continuously available. However, effective healthcare service delivery in public health facilities is mainly hindered by a lack of essential drugs. This situation mostly occurs in African countries. It is estimated that about 30% of the world's population lacks medicines they so much need to manage several conditions. (1)

Every healthcare system targets to meet patient satisfaction but this is closely dependent on the timely availability and accessibility of essential drugs and other medical supplies. Thus, Inventory management of medicines is qualified as the backbone of healthcare system delivery. Proper inventory management practices are indispensable to avoid drug stock outs and to maintain good stock levels of medical supplies particularly in public health institutions of developing countries. Pharmaceutical inventory management is a complex system but critical process within the healthcare delivery system. It may also be considered a systematic approach to sourcing, receiving, storing, issuing, and replenishing a given group of health products. (2)

Among various supply chain management (SCM) issues, inventory management is most important to the entire supply chain to a more significant extent. Proper inventory management ensures a constant supply of products to patients, avoiding product stockouts and lowering inventory holding costs. Poor inventory management, on the other hand, could result in overstocking or understocking of essential medicines, wasting resources, and increasing morbidity and mortality due to a shortage of life-saving treatments. (3)

In developing countries, many previous studies have mostly focused on assessing drug availability of program products like malaria, HIV/IDS, and tuberculosis and few studies have addressed the drug shortages in the provision of maternal health care services. (4).

Postpartum hemorrhage (PPH) is clearly the leading cause of maternal mortality, with Africa accounting for half of all PPH occurrences (5). The two main causes of almost half of maternal deaths are excessive bleeding after childbirth (PPH) and preeclampsia/eclampsia or dangerously high blood pressure during pregnancy and these cases can be treated and prevented.

Effective and affordable medicines to treat PPH and PE/E and prevent maternal deaths are available. If made widely available, three low-cost drugs could save many women's lives.: Oxytocin, Misoprostol, and Magnesium Sulfate. (6)

Oxytocin and Misoprostol are proven life-saving drugs to prevent and treat PPH. Magnesium sulfate is the medicine reputed for its effectiveness in preventing and treating life-threatening seizures caused by severe PE/E.

Oxytocin injections and misoprostol tablets are two of the most used oxytocic medications used to prevent and treat PPH. The WHO model list of essential medicines and the Rwanda National Classify of Essential Medicines for Adults both list them as oxytocics (uterotonics). (5)

To explore whether the pharmaceutical supply system of emergency obstetric drugs is effective, this research attempted to investigate the influence of inventory management practices on the availability of emergency obstetric drugs in public hospitals in the Southern Province of Rwanda. In addition, the challenges in inventory management were also identified.

1.2 Problem Statement

Shortages of maternal health medicines and medical supplies are a challenge faced by many African countries. This is the leading cause of poor quality of maternal healthcare services and, as result, maternal fatalities. Nearly all maternal deaths, according to estimates, occur in developing countries, primarily among women living in rural regions. (5). Maternal mortality is high prevalent the poor communities and particularly in rural areas. On the other side, these deaths could be prevented if women received adequate maternal health services, including quality emergency obstetric care.

Quality emergency obstetric care has recently been promoted as a cost-effective way to prevent maternal deaths. (7). However, emergency obstetric care (EmOC) assumes that obstetric complications can occur in about 15% of deliveries worldwide and that maternal complications are unpredictable in many cases (8).

Maternal deaths may be prevented if skilled health personnel, medications, and medical supplies needed for emergency obstetric care were accessible when these complications arose.

Research on maternal health care and the quality of emergency obstetric care has focused mainly on addressing the shortage and need of skilled personnel and the difficulties in referral systems This might theoretically lead to the conclusion that EmOC coverage has improved. In practice, due to a lack of medicines and medical supplies, access to and use of such facilities may be limited. Only a few studies have looked into the impact of drug availability on maternal health. (4)

The unreliability of obtaining drugs and medical supplies resulted in untimely and suboptimal EmOC services (6). There exist several reasons why pharmaceuticals deserve special consideration in controlling inventory.

According to a research conducted in Bungoma County, Kenya, to determine the extent to which inventory management techniques influence medicine availability in public health facilities, the county's average out-of-stock days were 51.30 days. The main challenges identified with inventory management practices were a lack of guidelines, SOPs, and a reliable inventory management system, as well as insufficient and incompetent pharmaceutical personnel, all of which were found to have a negative impact on the availability of critical medicines throughout the supply chain. (1)

Another study conducted in Ethiopia on the availability of essential medicines and pharmaceutical inventory management practice at health centers of Adama town unveiled that the availability of essential drugs was low. For the study period, certain HCs had poor inventory management practices, with the average length of Stock days for tracer medicines during the previous 12 months from each HC being 40.6 days.

It is imperative to put in place a multi-pronged approach for addressing challenges in the health system that impede accessibility and availability to essential maternal health drugs and medical supplies. In addition, there should be a particular focus on improving inventory management practices for the drug delivery system.

Considering that maternal drugs and supplies are critical, two scenarios are likely to occur: understocking and overstocking. The first may increase maternal morbidity and mortality, whereas the last can contribute to the wastage of resources due to expiries. This situation may result mainly from poor inventory management within health facilities. As a vital component of the

pharmaceutical supply system, appropriate inventory management helps maintain a continuous drug supply and customer satisfaction to patients, preventing medicines stock out while minimizing the costs of holding an inventory. An assessment of the influence of inventory management practices on the availability of emergency obstetric drugs in Rwanda's public hospitals, therefore, needed to be conducted to illuminate an accurate picture of where the issues of accessibility and availability of emergency obstetric drugs arise and provide necessary recommendations.

1.3 Purpose of the study

The goal of this study is to evaluate current inventory management practices and make recommendations on what should be done better or differently in public hospitals in Rwanda's Southern Province.

1.4 Objectives

1.4.1. General Objective

The main objective of this study was to investigate the influence of inventory management practices on the availability of emergency obstetric drugs in Rwanda's public hospitals: in the Southern Province of Rwanda. Moreover, to gain a better grasp of the problem and to suggest possible areas for improvement.

1.4.2. Specific Objectives

1. To describe the inventory management practices used for emergency obstetric drugs in public hospitals of the Southern province of Rwanda.

2. To evaluate the availability of emergency obstetric drugs in Rwanda's public hospitals in Southern Province, Rwanda.

3. To demonstrate to which extent inventory management practices influence the availability of emergency obstetric drugs in Rwanda's public hospitals.

4. To determine the challenges that affect inventory management of emergency obstetric drugs in the public hospitals of Rwanda.

1.5 Research Questions

1. What are inventory management practices used for emergency obstetric drugs in Rwanda's public hospitals?

2. What have been the stock levels of emergency obstetric drugs in the public hospitals of the Southern province of Rwanda?

3. To demonstrate the extent to which inventory management practices influence the availability of emergency obstetric drugs in Rwanda's public hospitals.

4. What challenges affect inventory management of emergency obstetric drugs in public hospitals in Southern province, Rwanda?

1.6 Significance of the study

The survey unearthed current practices in inventory management and isolated challenges. This information will be help to take appropriate decisions of improving health commodities management and for stakeholders to know areas to put much emphasis in ensuring commodity security of emergency obstetric care. The anticipated output of the study is to isolate the deficiencies of the current inventory management practices and availability of emergency obstetric drugs in public hospitals of Rwanda and consequently provide recommendations for policy and best practice.

1.7 Delimitations

The product availability indicators assessed were: Stock out rates, stock levels, and stock loss rate. The target population of the study was: the facility in charge, pharmacists, hospital administrators, and maternity ward midwives in control in all the ten public hospitals of the southern province of Rwanda, namely: Kigeme district Hospital, Munini district hospital, Kabutare district hospital, Kibilizi district hospital, Gakoma district hospital, Nyanza district hospital, Ruhango provincial hospital, Gitwe district hospital, Kabgayi district hospital, and Remera-Rukoma district hospital. In addition, the study will focus on the influence of inventory management practices on the availability of emergency obstetric drugs in Rwanda's public hospitals in the Southern province of Rwanda.

1.8 Limitation

Firstly, this research is only targeting the public hospitals in the Southern Province of Rwanda due to many constraints such as time and cost and the results may not be extrapolated to overall picture of inventory management practices in all health facilities in the Southern Province, as most public health facilities providing obstetric care are health centres, at lower levels. And teaching or referral hospitals are excluded from this research.

Secondly, this study focused only on emergency obstetric drugs. Therefore, the results cannot be generalized to the management practices of other group of products such as antiretroviral drugs, laboratory commodities or other essential drugs. Finally, as the completion of the questionnaires targeted middle and senior managers of the facilities in which they worked, and therefore their physical availability could be unpredictable.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

The introduction section, inventory management practices, availability of emergency obstetric drugs, and a review of the empirical literature on drug availability which constitutes the research gaps, are all included in this chapter. A conceptual framework has been established to show the link between the dependent and independent variables.

2.2 Maternal mortality status.

In 2017, an estimated 295,000 women died worldwide as a result of poor maternal health care and complications during pregnancy and delivery, with Sub-Saharan Africa having the highest maternal mortality rate. (9). For women in the developing world, maternal mortality and morbidity are the main contributors to the disease burden among women. It has been noted that postpartum hemorrhage (PPH) is the leading cause of maternal mortality, and a good number of all PPH cases and related complications occur in Africa. In the years 2000 to 2017, Rwanda, a low-income country in Sub-Saharan Africa, reduced its maternal mortality rate from 1160 to 248 per 100,000 live births. (5)

In recent decades, the probability of a woman dying from pregnancy and childbirth in Rwanda is one in ten, compared to one in 2500 in the United States.(10)

2.3 Emergency obstetric medicines.

2.3.1 Introduction

The two leading causes of maternal mortality are postpartum hemorrhage and preeclampsia/eclampsia, which account for nearly 50% of all maternal deaths worldwide. In almost all cases, these conditions could be treated or prevented.

In many low- and middle-income countries, women die daily due to poor quality maternal health care and stock out of essential medicines(5). Ensuring availability and accessibility to essential maternal medicines could save many women. Despite efforts and significant progress made to

avail these life-saving maternal health medicines access to these items remain a problem for many women, especially in the most vulnerable groups of people. (11)

However effective and affordable drugs are available to manage, prevent and treat PPH and PE/E, therefore avoiding maternal deaths. If made widely available, three low-cost drugs could save many maternal deaths.

PPH can be prevented and treated using the medications oxytocin and misoprostol. The most effective medicine for preventing and treating life-threatening seizures induced by severe PE/E is magnesium sulfate.

2.3.2 Oxytocin

During pregnancy labor, and breastfeeding the woman body secretes a natural hormone called Oxytocin. It can also be manufactured in synthetic form. The World Health Organization recommends oxytocin (WHO) as the first-line uterotonic for preventing and treating (PPH), this situation occurs when there are inadequate contractions of the uterus after childbirth. Its action results in stopping excessive bleeding by stimulating contractions.(12) Oxytocin is administered via two routes: IV injection into a woman's vein or intramuscular injection (IM). Its effectiveness is achieved in one to three minutes.

2.3.3 Misoprostol

Misoprostol is a safe, effective, and low-cost alternative to oxytocin, which is used to prevent and treat PPH. It simulates the natural childbirth process by generating uterine muscle contractions as well as softening and dilation of the cervix. Misoprostol is a useful alternative for preventing and treating PPH in situations where oxytocin is unavailable or difficult to administer.

2.3.4 Magnesium sulfate

Magnesium sulfate is used to treat a life-threatening condition represented by elevation of blood pressure during pregnancy and associated complications such as seizures and, liver and kidney damage. It's a low-cost, effective, and safe way to prevent and treat preeclampsia and eclampsia. In severe cases, PE/E can cause a pregnant woman and her baby to die.

The medicine is also included in the many countries EMLs as a priority medication in clinical treatment guidelines and protocols around the World (5).

2.4 The importance of the availability of drugs and medical supplies in emergency obstetric care

An inadequate supply of life-threatening medicines, such as oxytocic, antibiotics, and anticonvulsants, impacts the acceleration of maternal complications and mortality. Maternal mortality is frequently linked to ineffective implementation and inadequate inventory management practices in availing emergency obstetric medicines and medical equipment. (13) Medicines are crucial to ensuring the quality of obstetric care services in reducing maternal mortality. During the study, it was found that there was a shortage of parenteral drugs in both cascades, often used for unconscious patients.

According to a study conducted in the Lindi and Mtwara regions of Tanzania, oxytocin, an essential medicine for preventing and treating postpartum haemorrhage (PPH), was not available in most of the facilities visited. (6)

The studies have unveiled that nearly 99% of all maternal deaths occur in developing countries and these occur mainly among women living in rural areas (10). The majority of these deaths may be avoided if women had access to sufficient maternal health medicines, particularly quality emergency obstetric medications.

According to the study, rural health facilities' procurement of EmOC and medical supplies is unreliable, jeopardizing the timely delivery of quality EmOC. Promoting transparency and accountability in the management of drug funds, and setting up a reliable health supply system could improve this situation.

According to the Nigeria studies, the results revealed that there was an inadequate supply of emergency obstetric drugs and related consumables at a rate of 61%. (14)

2.5 Inventory Management Practices

2.5 1. Introduction

This section briefly describes the inventory management concept, stock control models, ordering procedures, store management practices, and Stock keeping records.

In general, inventory management is defined as ordering, handling, storing, and utilizing a company's non-capitalized assets. Inventory management has become one of the critical elements of supply chain management and can significantly affect a company's performance (15)

In order to ensure the effectiveness of the medicines supply chain, it is critical to review and monitor inventory management practices on a regular basis. Poor inventory management mechanisms always have a negative impact on pharmaceutical availability; pharmacy inventory management is a complex but vital process in the healthcare delivery system. In the absence of proper pharmaceutical inventory management methods, hospitals run the risk of not being able to offer patients the most appropriate medication when they need it.

An inventory management system in a health care environment aims to maintain a steady supply of medicines and services to patients by determining the needed quantity and the right time to place an order for replenishment or issue to clients. Orders should be placed in a timely manner to ensure that drugs are always available. (16) For a proper quantification, it is most important to take into consideration past and current drug consumption data at the health facility level (17)

It is critical to perform a proper quantification of medical products taking into account all requirements to estimate actual needs. Failure to do it can lead to poor budgeting of medicines funds and perhaps insufficient funds may be allocated for life-saving medicines (Clark &Barraclough, 2010). Successful inventory management is characterized by maintaining sufficient stock to avoid shortages, avoid overstock and confront fluctuation within supply chain management. (18)

2.5.2 Practices: Inventory control system

2.5.2.1 Introduction

Inventory control is concerned with maintaining a balanced supply by physically controlling product quantities in the store. It helps determine what to keep in the shop, when to keep it, and how much to keep it in order to avoid shortages and pilferage, as well as to reduce insufficient supplies.

In stock control, several strategies are adopted: ABC system, maximum-minimum, rationing system, and EDV (4). Maximum-minimum inventory control has proven to be the most effective in Deliver's experience. Inventory levels in this system are based on previous consumption trends; this method can assist avoid stock imbalances by limiting the danger of stock-outs and overstocking, as well as lowering the number of emergency orders generated by inadequate stock management. The minimum-maximum inventory control system also enables demand-driven replenishment. It keeps track of safety supplies in the hopes of having dugs available whenever they are needed.(20) However, in Tanzanian public hospitals, there was a lack of knowledge of inventory control methods; the majority of Staff (65%) in hospitals in Dar es Salaam were not aware of any of the inventory control techniques applied in inventory management. As a result, there was a poor estimation of needs, leading to overstocking of medicines (4)

2.5.2.2. Minimum-maximum inventory control system

The medical resupply model is determined in the healthcare environment by the replenishment trigger used. The replenishment trigger decides which model is employed in pharmaceutical supply systems. For example, the minimum-maximum inventory control method is the most preferred for managing medical health supplies. Stock levels are managed within a predetermined range in this technique, with the highest limit referred to as maximum stock and the lower limit referred to as minimum stock. According to USAID/Deliver, there are three types of stock control systems: forced orders, standard orders, and continual reviews. (21)

A review period is used as the reorder notification in a stock control system known as a forced reorder system. At the end of each review period, stock levels are examined, and the amount to be

reordered is decided by the deficit required to bring stock quantities up to the maximum stock level.

When a certain item exceeds the minimum stock level in a continuous review system, the request is launched. This system has some advantages and disadvantages, the first being the elimination of small orders while the second makes it difficult to organize transport because orders are placed at any time after an item reaches the minimum stock level.

When using the standard system, orders are placed only for products that reach the minimum stock quantity at the end of the review period. (17)

2.5.3.3. Determination of quantities to order

The pharmaceutical ordering process requires the involvement of various parameters to base on in order to have accurate data on needed quantities in a timely manner. The common assumptions are monthly consumption data, re-order levels, security stock, current stock on hand, lead time, and the procurement period.

The research has revealed that the lack of basic re-ordering competencies and skills at all levels in inventory management practices, such as not knowing how to calculate average months of stock or calculating orders on maximum and minimum quantities, was found to be a factor contributing to poor performance of supply chain management and drugs mismanagement (21). A supply chain manager must be able to forecast future demand and accurately determine how much to order for a given product. MSH has described four methods that can be useful in calculating the amount to order. Those forecasting methods are a projective method, morbidity-based method, causal and judgmental. (22). The projective techniques rely on past consumption patterns to predict future demand.

The causal method takes into account some factors that may affect demand, but the demand must be correlated with these known factors such as changes in the size and structure of the health system, epidemics, market conditions, and seasonality.

The judgmental method is somehow subjective because it relies on individual forecasts and estimates. The opinion of experienced staff is given much importance in estimating future demand.

The morbidity-based method relies on requirements such as rates and data on the incidence of health problems, standard treatment guidelines for a given health condition and the expected number of attendances to project demand.(23)

2.5.3.4. Record keeping in inventory management.

The main source of data in inventory management is the stock record which can be either electronic or manual. Whether stock records are manual or electronic, their data must be up-to-date and accurate. Some reasons can cause inaccurate data on the stock record, which are avoidable. These include infrequent physical counts, theft, inadequate training of stock management staff, removal of expired or damaged products that are not removed from stock records, and storage of Stock records of an item in different locations due to poor storage practices. (18)

According to the MSH, the stock card or ledger is the most essential record in pharmaceutical management (22). Product description, storage conditions, shipping unit, batch number, expiry date, columns and rows to show date, entries, difficulties, and balance should all be included in an ideal stock card. Stock records should include the stock on hand or current stock balance, losses, and modifications for each health product, according to the USAID|DELIVER project. (17)

A study in Tanzania revealed that stock records were inaccurate and incomplete. The problem was due to the existence of many record books to be filled in and the fact that only one person was responsible for issuing and recording transactions at the same time on the stock card. Some tracking items in the hospitals visited did not have bin cards. (4)

2.5.7. Inventory management practices in use across the Rwandan public health care system

The main areas of interest of this research are the assessment of the influence of inventory management practices in Rwandan public hospitals, inventory control models and replenishment triggers, how quantities to be ordered are determined, accuracy and updating of stock records, and reporting. Each hospital has an on-site pharmacy, which is under the control of the health facility

management. The Rwanda Medical Supply ltd branch, managed by the district pharmacist, supplies medicines to the district hospitals and other health facilities in its catchment area. Pharmacists run the pharmacies in the district hospitals. Each pharmacy has two units: the main warehouse, where products from the RMS ltd branch or other sources are stored, and the dispensing point, where patients receive medicines. The warehouse managers are responsible for distributing medication in the main warehouse and at the dispensing end. Each month, all pharmacies take a physical inventory of each of the products stocked for subsequent reporting and requisitioning to the RMS ltd. Branch. Consequently, through monthly active distribution, the RMS ltd. Branch dispatches and delivers to each health center according to the products ordered and the available Stock.

In logistics management, reports move information forward or backward to provide guidance decision-makers to take appropriate actions. If the information is not available to managers for decision-making, stock records are useless in this case. The Ministry of Health has adopted an electronic Logistical Management Information System (e-LMIS) to improve stock management and the stock card and ledgers, as well as to standardize best practices and ensure the timely availability of accurate logistics data for informed decision making.

2.5.8. Inventory management practices and drug availability

A study was conducted by Onyango in Kenya to assess inventory management practices mainly for fast-moving consumed products in Nairobi has identified inventory models such as just-in-time, material requirements planning, enterprise resource planning, economic order quantity, and supplier-managed inventory as inventory practices in use. The findings revealed that these inventory practices improved supply performance. (14) The research gap in this study is that it mostly focused on the demand-dependent inventory system..

In contrast, the pharmaceutical supply chain, as it deals with finished products, mainly uses the independent demand system. In the study conducted in Bungoma, Kenya, which assessed the influence of inventory management practices in public health facilities, the study identified four major inventory management issues: a lack of a central county warehouse, a staffing shortfall, an ineffective inventory management system, and a lack of inventory management guidelines. From

the results, it is clear that inventory management practices directly influence the availability of medicines. (1)

2.6 Conceptual framework of the study.

A conceptual model of this study has been developed and is illustrated in the figure below. Therefore, this study reflects practices that should be investigated: inventory control model, and stock replenishment triggers (how to order quantities are determined and updating of stock records affect the availability of emergency obstetric drugs, which will be measured in terms of out-of-stock rates, Stock according to plan, overstock rate.

In other words, improved inventory management practices will enhance the availability of health products by reducing stockout rates and stock loss rates and improving healthcare services.

In other words, improving inventory management practices will enhance health commodity availability by reducing Stock out rates and stock wastage rates.

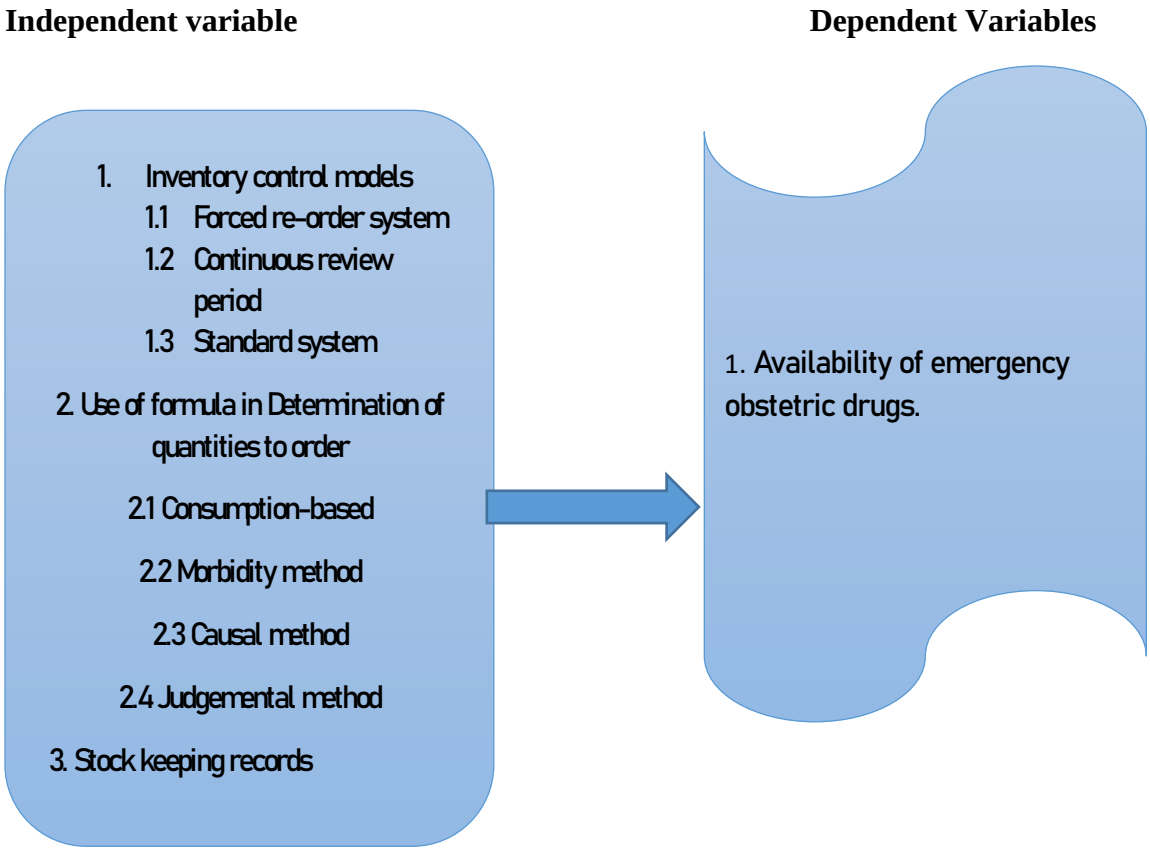


Figure 1: Conceptual framework

CHAPTER THREE: METHODS

3.1 Research Design

This study adapted and used a descriptive research design because it involves describing conditions that exist, in this context, assessing the influence of inventory management practices in the target population of public hospitals across the southern province of Rwanda.

The researcher was able to draw valid and dependable conclusions and recommendations using a mixed-method approach in which quantitative and qualitative methods were combined to investigate the relationship between inventory management practices and stock status of emergency obstetric drugs in Rwandan hospitals and related challenges.

3.2 Target and Study Population

The research was carried out in Rwanda's Southern Province, which is one of the country's five provinces and has an area of 5,963 km2. In the south, it shares a border with Burundi.

It has eight units known as Districts. In the Rwandan health system, each District has at least one district hospital. This hospital treats mainly the patients referred from health centers within district boundaries. At this level of healthcare service, two or more general medical doctors are available, while nurses manage lower levels of health centers. Every month, the district hospital procures medicines from the District branch of Rwanda medical supply limited. The hospital pharmacist receives drugs and medical supplies in the central pharmacy and then distributed in different hospital subunits, including the maternity ward. Inclusion criteria were the presence of the leading

hospital pharmacy and dispensing unit, Emergency obstetric drugs, and personnel working at the site for at least 18 previous months.

This study included all district hospitals in Rwanda's South Province. Three emergency obstetric drugs (EmObs) were used to examine the availability of emergency obstetric drugs on the survey day and over the previous 18 months. Oxytocin injection, Misoprostol pill, and Magnesium sulfate injection were the emergency obstetric medicines used in this trial.

The description below shows the recruited study population. All health workers were picked from all the ten public hospitals in Southern Province as the study population. The total study population recruited was as follows:

Table 3. 1: Health workers recruited for the study

Name of Hospitals	**Responsibility of Responded**	**Number**
Munini DH,Kigeme DH,Kibirizi DH,Gakoma DH,Kabutare DH,Nyanza DH, Gitwe DH,Ruhango PH,Kabgayi DH and Remera-Rukoma DH	Pharmacist in charges	10
Munini DH,Kigeme DH,Kibirizi DH,Gakoma DH,Kabutare DH,Nyanza DH, Gitwe DH,Ruhango PH,Kabgayi DH and Remera-Rukoma DH	Medical Doctors working in maternity Unit	10
Munini DH,Kigeme DH,Kibirizi DH,Gakoma DH,Kabutare DH,Nyanza DH, Gitwe DH,Ruhango PH,Kabgayi DH and Remera-Rukoma DH.	Directors of Administration and Finance	10
Munini DH,Kigeme DH,Kibirizi DH,Gakoma DH,Kabutare DH,Nyanza DH, Gitwe DH,Ruhango PH,Kabgayi DH and Remera-Rukoma DH.	Midwives/ Nurses in charge of maternity Unit	10
	TOTAL	**40**

3.3 Samples

Concerning this study, the census method of sampling was used. This is due to the small study population of those health personnel managing pharmaceutical products in the public hospitals. This method uses the entire study population as the sample. Therefore, all the above 40 officers in the study population were used as the sample.

All workers were visited at their workstations, and data was collected using appropriate data collection tools.

3.4 Data collection instruments

This study's primary data collection instruments were structured questionnaires, key informant interviews, and checklists. Secondary data were also collected from inventory management tools. Checklists were used to record the availability of emergency obstetric drugs in the last 18 months. Key informant interviews were used to provide in-depth information on the topic. Finally, the e-LMIS and other stock records extracted historical logistics data that facilities typically report every month to calculate stock levels such as shortages, stockouts, or overstocks.

3.5 Pre-Testing

Two district hospitals in Kigali were selected as pre-testing sites and did not participate in the study. Masaka and Kibagabaga district hospitals were the most suitable due to their geographical proximity, similarity in service delivery, and drug management system.

3.6 Validity

According to Fiona Middleton, validity refers to the accuracy with which a method measures what it purports to measure. For this study, questionnaires were used to collect interview data and records.

3.7 Reliability

The degree to which a research approach delivers solid and consistent outcomes is known as reliability.

3.8 Data Collection techniques

The questionnaires were distributed to participants using the "drop off and pick up later" technique as the first phase of data collection. This gave respondents sufficient time to complete the questionnaires. The researcher distributed the questionnaires. A sample of the questionnaire used can be found in Appendix 2.

The second phase involved collecting the questionnaires, which doubled up as a site visit to complete the checklist provided and check stock records. Again, this was done by the principal investigator.

The third phase involved conducting a key informant interview with the focused participants to provide in-depth information on the inventory practices and availability of Emergency Obstetric medicines in hospitals in Southern Province. The principal investigator did this with the permission of the Hospital Authorities.

3.9 Data Analysis

The quantitative data collected from the questionnaires and checklists was checked for completeness, categorized, and entered into STATA 13. We ran univariate, bivariate, and logistic regression analyses. Both qualitative and quantitative methodologies were used to analyze the data. The frequency distribution and percentages were calculated using descriptive statistics. The Chi square test was also employed to see if there was any correlation between the variables. Tables were created from the analysed quantitative data.

The qualitative data was tape recorded, translated, transcribed, and grouped into themes according to the research purpose, then delivered in narrative style with quantitative data presentations.

To identify the inventory management practices used for emergency obstetric drugs in the public hospitals of the southern province of Rwanda, the descriptive statistic method of frequency was used to demonstrate which techniques are primarily used and which ones are least used from the

respondents' feedback. Each parameter under question was then rated as a percentage by all the respondents.

Challenges affecting inventory management practices were ranked by getting the challenge with the highest frequency that the respondents agreed to as the most significant challenge. The rest were listed in descending order. The data was then presented in a table.

To determine the Stockout parameter, the total number of days of Stock out of emergency obstetric drugs was divided by the total number of days expected to be available. Then, an average was done to get the average Stockout rate of all the ten public hospitals, and this data was presented in a table.

3.10 Ethical Considerations

This study collected data through questionnaires used exclusively for educational purposes. The researcher observed and respected several research ethics, such as objectivity and integrity.

Therefore, there is no risk, as only general information from the district hospital was shared, not the individual picture.

CHAPTER FOUR: RESULTS PRESENTATIONS

4.1 Introduction

In this section, the key results and findings of the study are presented. Questionnaires were used to collect primary data, whereas secondary data were extracted from hospital records and key informant interviews. They give a descriptive summary of hospital inventory management practices and associated challenges. A bivariate statistical test was used to present and interpret the results to evaluate the associations of dependent and independent continuous variables. The results are shown in graphs, charts, and tables.

4.2 Characteristics of study participant

The survey was carried out in all ten district hospitals in the Southern province of Rwanda. Supply chain management of emergency obstetric drugs was assigned to pharmacists in 80% of hospitals and nurse store managers in 20% of hospitals. Another study population comprised 10 (26.31%) Medical Doctors, 8 (21%) hospital administrators, and 10 (26.31%) Midwives. Out of 40 questionnaires, 38 were completed, and a response rate was scored at 99.5%. Regarding their years of experience, twenty-seven (71%) respondents had worked for between 1-and five years, while 29% had more than five years of experience in emergency obstetric drugs management and use.

Table 4.1. Characteristics of study participant (n=38)

Variable	Frequency	Percentage
Type of personnel	8 Pharmacists	8 (21%)
	2 Nurses store managers	2(5.2%)
	Medical Doctors	10 (26.31%)
	Midwives	10 (26.31%)
	Administrators	8 (21%)
Sex	Male	22 (57.89%)
	Female	16 (42.1%)
Age (years)	Below 30 years	0 (0%)
	30 – 40	12 (31.57%)
	40 – 50	18 (47.36%)
	Above 50	8 (21%)
Work experience (years)	Below 1 year	0 (0%)
	1 – 5	27 (71%)
	5 – 10	9 (23.68%)
	Above 10	2 (5.26%)

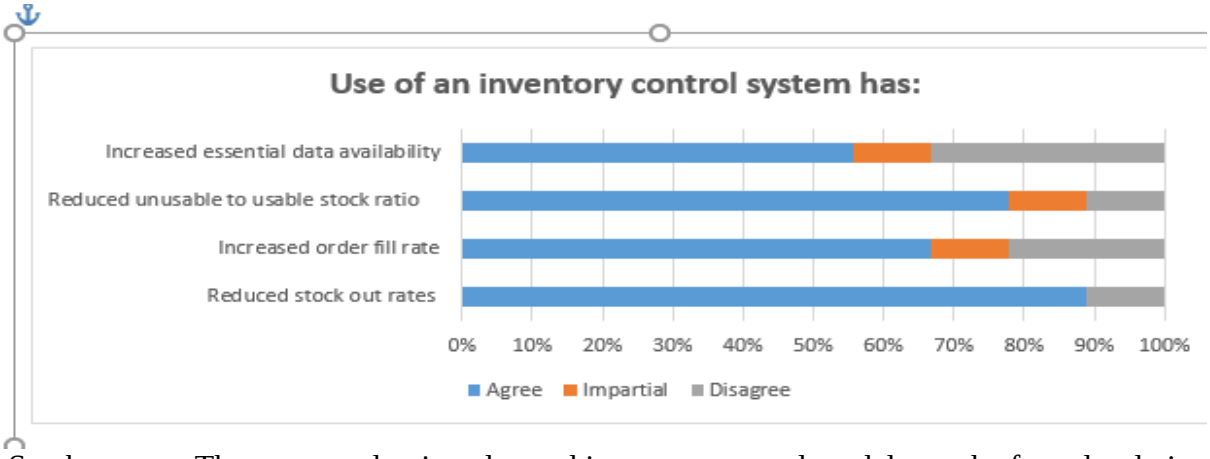
4.3 Inventory Management Practices

This section summarizes the inventory management practices, including the inventory control models, order quantity determination, logistic management tools, and storage conditions.

Out of 10 hospital pharmacists questioned, nine responded to the inventory management practices used for emergency obstetric drugs in Rwandan hospitals, South Province. Therefore, the analysis was done separately on three identified inventory management practices.

4.3.1. use of an inventory control system.

Figure 1 below describes the respondent's views on using inventory management in emergency obstetric drugs, whereby about 85% agree that the use of an inventory control system has reduced



the Stockout rate. The most predominantly used inventory control model was the forced ordering Max-Min inventory control system.

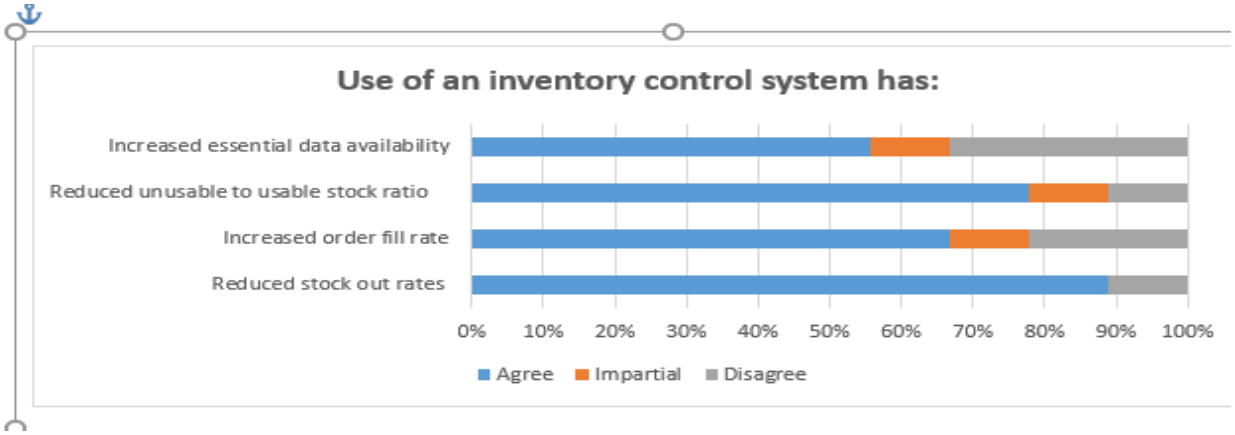


Figure 1: Use of Inventory control system

4.3.2. Use a formula in the Determination of quantities to order

Figure 2: Determination of quantities to order

Figure 2 shows that 79% of pharmacists agree that using past consumption patterns as a formula in determining quantities to order has reduced the unusable to usable stock ratio and increased order fill rate. The methods used to assess the needed quantities, according to obstetric medications management staff, include using consumption trends with stock on hand.

4.3.3. Stock keeping records

According to participants, as described in **figure 4**, having and completing Stock keeping records plays a major in reducing emergency obstetric drug stockouts and increasing essential data availability.

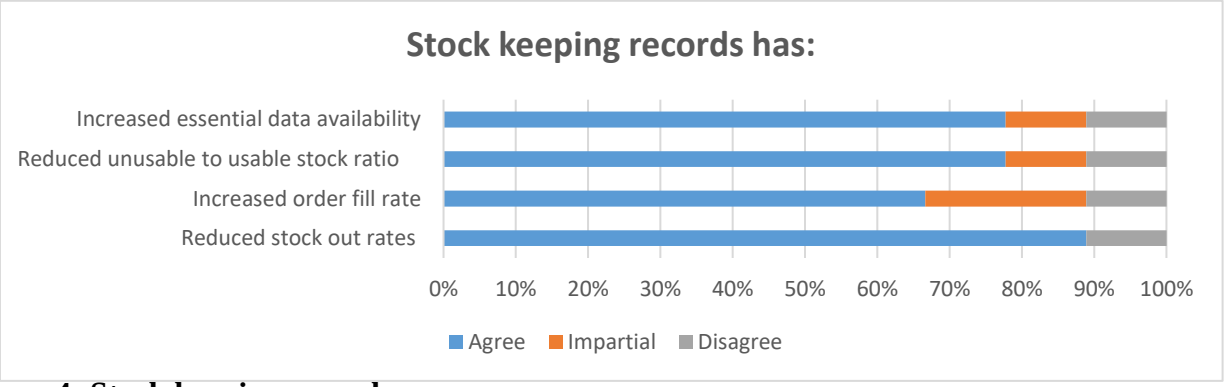


Figure 4: Stock keeping records

The majority (80%) expressed that the Stocktaking was done every month.

Table 4.2: Logistic tools in use

Sample Characteristic	**Number and percentage of hospitals (n)**
Types of a logistics system for EmOBs (n=9) Stock card Electronic only Both system	 0 (0.0%) 1(11.2%) 8 (88.8%)
Presence of logistic tool and compliance Presence of any logistic tool N=10 No logistics tool N=10 Compliance on the logistics tool (for 3 EmOb drugs stored in 10 hospitals) N=30 All logistics tool updated N=10	10(100%) 0(0.00%) 26(86.6%) 3 (30.0%)

Stock out information Stockout on the logistic tool in the last 18 months (N=30) Stockout on the day of visit (N=30)	 11(36.6%) 7 (23.3%)

The above table 4.2 showed that electronic software and manual forms are main logistics management tools used by hospitals to manage health products. The manual logistics tools are stock cards, daily consumption registers, and internal requisition forms. At the same time, electronic software is an electronic management information system (e-LMIS). Stock cards for emergency obstetric drugs were present at 88.8% of all hospitals (Table 4.2). Data on emergency obstetric drugs were recorded on the logistics tools at 86.6% of all hospitals.

4.4. Stock levels of emergency obstetric drugs in the public hospitals of the Southern province of Rwanda

This section highlights the ratios in the availability of emergency obstetric drugs in terms of stock levels, order fill rate, months of Stock, wastage rate, and lead time rate.

4.4.1 Order fill rate

All emergency obstetric drugs were ordered and supplied from RMS Ltd branches. According to respondents, not all quantities purchased are always delivered; a pharmacist reiterated that" *Nowadays, all orders are placed through electronic software, called e-LMIS and former district pharmacy considers consumption data captured in e-LMIS and Stock on hand that system displays during order validation. If those data are not accurate, requested quantities may change"*. However, only 60% of the hospitals had a total supply of the previous order placed upon observation. Nonetheless, at 88.8%, the average order fill rate was relatively high.

Table 4. 3: Hospitals' emergency obstetric drugs supply status

Features of sample	**Percentage of orders processed (=18)**
-Supply rate Fully order received Partially order received Order not served.	 10(55.5) 6(33.3) 2(11.1)
-Lead time	

Seven days and above	5(27.7)
Three days	9(50)
Two days	2(11.1)
One day	2(11.1)

4.4.2 Months of Stock and stock levels of Emergency obstetric drugs

The lack of data on the logistics tools made it impossible to estimate the number of months of stock held at the hospital. Furthermore, it was impossible to estimate the months of stock stored at the hospital due to inadequate month-end data required to determine months of stock of EmObs medications held at hospitals. All respondents reported using the Maximum-Minimum system to monitor the stock levels of EmObs; one participant said, " *At district hospital, we keep a maximum stock of two months and minimum stock of one month as our ordering period is monthly."*

However, the majority of hospital pharmacy personnel didn't care about completing the column showing the month of Stock after each stock card transaction and a nurse store manager replied, *"Here in the pharmacy, we are overwhelmed and calculating the month of stock after each transaction takes a long time."*

Stock levels were calculated based on the months of Stock. Stock is according to plan when availability ranges between one to two months of Stock. We considered the availability as the risk of Stock out when months of stock range between 0.5 and 1 month of Stock, above two months, is taken as overstock and below 0.0 MoS is taken as Stock out, taking into consideration one week of lead time.

The results showed that 18 months ago, and the day of the visit, there was no Stock out of oxytocin in 60% (n=10) of hospitals, and the same product was in overstocked range at 80% (n=10) of hospitals visited. Magnesium sulfate injection fell into Stock out in 70% of hospitals, and the days of Stock out ranged between 16 days (2.96%) and 96 days (17.7%) in the last eighteen months. For Misoprostol, only three hospitals (30%) experienced Stock out during the study period, and days of Stock out ranged between 10 days (1.8%) and 32 days (5.9%).

Misoprostol and Magnesium sulfate presented to last a long period (60.7%) where these products are in an overstocked state in most of the hospitals visited (80% n=10).

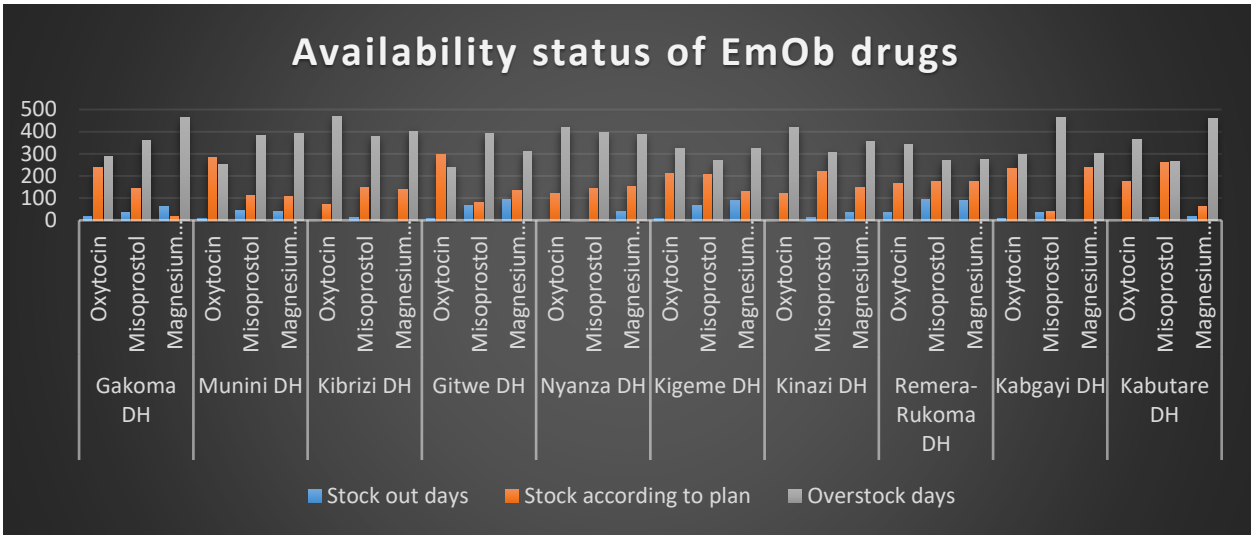


Figure 5: Individual Stock status of emergency obstetric drugs within the last 18 months (n=540)

Table 4. 4: Cumulative stock levels of emergency obstetric drugs.

Row Labels	Stockout days	Stock according to plan	Overstock days
Magnesium sulfate inj	467	1303	3668
Misoprostol	383	1532	3485
Oxytocin	79	1907	3414
Grand Total	**929**	**4742**	**10567**

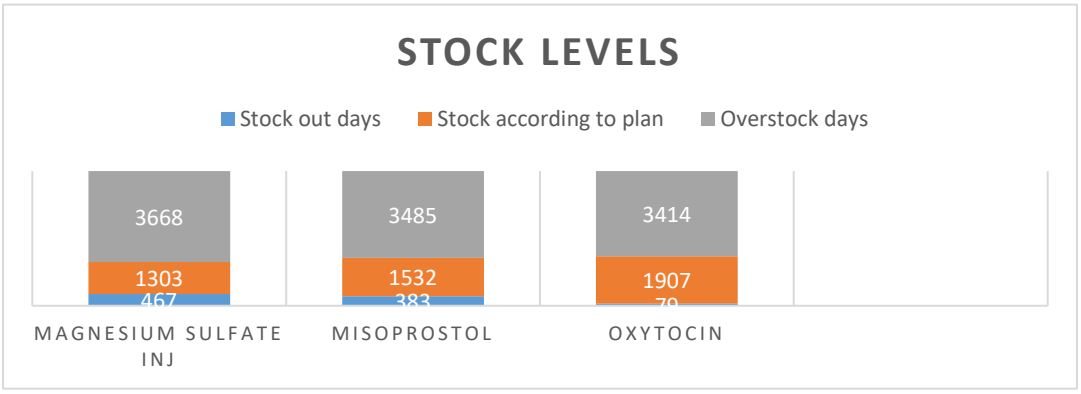


Figure 6: Stock levels of emergency obstetric drugs in the public hospitals

The results in **figure 6** show that Magnesium sulfate injection is the one faced more days of both Stockout and overstock followed by Misoprostol. On the other hand, oxytocin faces the least days of Stock out but more days of Stock according to plan.

4.4.3 Emergency obstetric drugs supply lead time and stock wastage rates.

The lead time of emergency obstetric drugs supply was measured by comparing how many days took to deliver the drugs from the moment of placing the order and the time of receiving a shipment of emergency obstetric drugs. From the day of the visit to the last three months, the order lead time is shown below.

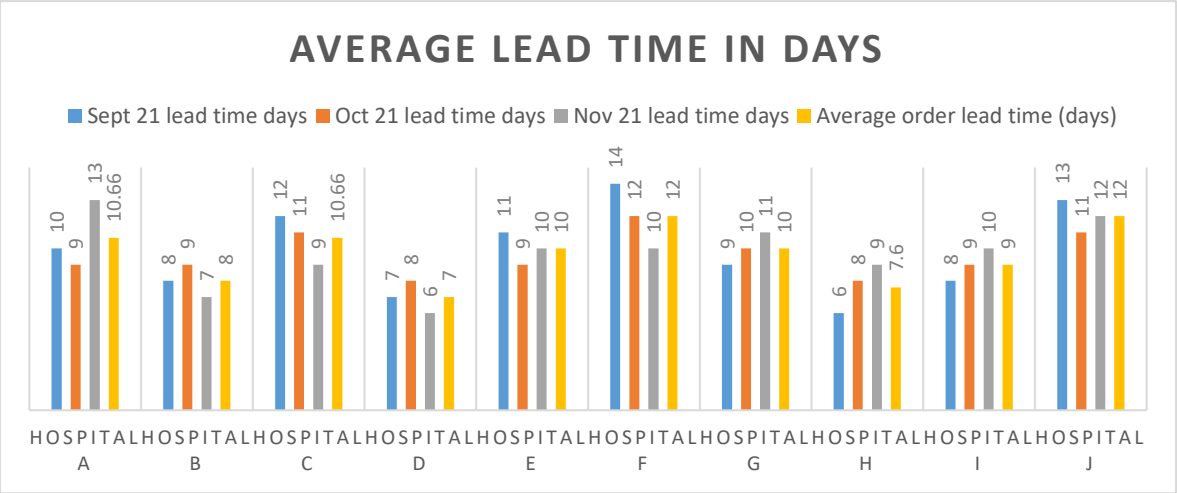


Figure 7: Supply lead time of emergency obstetric drugs for three last deliveries

The order lead time ranged from the shortest of 7 days in Hospital D to the longest of 12 in Hospital F and J, with an overall average of 9.66 days.

Stock wastage rate was evaluated for all the eight participating hospitals by comparing the unusable Stock of emergency obstetric medicines to the Total Stock on hand (usable and unusable) of that regimen, as summarized in **table 7** below:

Table 4. 5: Stock wastage rate of Emergency obstetric drugs

Hospital Name	**EmOb drugs expired**	**Unusable Stock**	**Usable Stock**	**Stock wastage rate(%)**
Hospital A	Misoprostol	280	3210	8.02
	Magnesium sulfate	32	152	17.39
Hospital B	Misoprostol	362	3968	8.36
Hospital C	Misoprostol	20	100	16.60
	Magnesium sulfate	10	54	15.62

Hospital E	Misoprostol	386	5812	6.22
Hospital F	Magnesium sulfate	38	218	14.81
Hospital H	Misoprostol	654	4718	12.12
	Magnesium sulfate	75	450	14.28
Hospital J	Magnesium sulfate	50	320	13.51

The absence of wastage was noticed for oxytocin injection, and the highest wastage is 12.1% and 17.39%, respectively, for Misoprostol and Magnesium sulfate inj. Three hospitals among ten visited didn't experience any wastage for emergency obstetric drugs during the period under review.

4.5. Influence of Inventory management practices on the availability of emergency obstetric drugs.

The chi-square test was used at a 5% level of significance to see if the variables of interest for each set of hypotheses had a significant association with the result variable. Further tests were carried out to see how much the significant variables contributed to the changes in the outcome variable. Among the collection of variables that were moved out to measure the availability of emergency obstetric medications, "Stocked to plan" was chosen as the best presentation of any confounding factors.

The null hypothesis states that: ***"There is no significant relationship between current inventory management practices and the availability of emergency obstetric drugs in Rwanda's public hospitals, South province."***

Table 4.6.: logistics tools updated and drug availability status.

Logistics tool updated? Yes or no	Drug availability availability 0	1	Total
0	7	2	9
1	2	19	21
Total	9	21	30

Pearson chi2(1) = 13.9758 Pr = 0.000

The above table shows the Chi-square output between logistics tools updated and drug availability status. Regarding the variable **'*Logistic tool updated*,**' the study indicates that updated logistics tools are significantly associated with *"**Drugs availability in the hospitals***." The conclusion was arrived at by comparing the p-value =0,000 < 0.05; the Null hypothesis is rejected and concluded that there is a significant relationship between current inventory management practices and emergency obstetric drugs in Rwanda's public hospitals in South Province.

Table 4.7: Influence of updating logistic tools and drugs availability

```
Logistic regression                             Number of obs   =         30
                                                LR chi2(1)      =      13.91
                                                Prob > chi2     =     0.0002
Log likelihood = -11.371692                     Pseudo R2       =     0.3795
```

LogisticstoolupdatedYesorno	Odds Ratio	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Drugavaialabilityavailability	33.25	36.35502	3.20	0.001	3.900331	283.4535
_cons	.2857143	.2290811	-1.56	0.118	.0593543	1.375345

Attempt to assess the extent to which logistics tools updated would vary along with the outcome variable *"Drugs availability in the hospitals"* the analysis shows that in such a situation, 62.05% of the variations in obstetrics drugs availability would be as a result of its dependence on **Logistic tool updated.**

The odds ratio shows that hospitals with updated logistics tools for their health facilities were 33.25 times more likely to have their ***obstetric*** drugs ***in*** Stock than those that don't update their Stock updated in their logistic tool. Logistic tool updated to refer to all stock indicators used to determine the quantity of medicine to be procured or Validated.

Table 4.8.: Last stock balance recorded on logistics tools (without correcting errors) and Obstetrics Drug Availability

Last stock balance recorded on logistics tools (without correcting errors)yes or	Drug avaialability availability 0	1	Total
0	6	2	8
	5.4	2.3	7.7
1	3	19	22
	2.0	0.8	2.8
Total	9	21	30
	7.4	3.2	10.5

Pearson chi2(1) = 10.5195 Pr = 0.001

Variable "**Last stock balance recorded on logistics tools (without correcting errors)"** was found to be a significant variable in explaining the availability of emergency obstetric drugs since χ2-value =10.5195 > the test value 3.864, and the same conclusion was arrived at by comparing p-value of 0.001 < 0.05,

```
. logistic Laststockbalancerecordedonlo Drugavaialabilityavailability

Logistic regression                             Number of obs   =         30
                                                LR chi2(1)      =      10.13
                                                Prob > chi2     =     0.0015
Log likelihood = -12.332964                     Pseudo R2       =     0.2911
```

Laststockbalancerecordedonlo	Odds Ratio	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Drugavaialabilityavailability	18.99999	19.49358	2.87	0.004	2.543544	141.9279
_cons	.5	.3535534	-0.98	0.327	.1250488	1.999219

The assessment of the extent to which the variable "**Last stock balance recorded on logistics tools (without correcting errors)"** is left single handily in the model to vary the outcome variable *"Drug availability in the hospitals*," as shown by the coefficient of Determination 70.89% of the total variation in variable "Availability of emergency obstetric drugs" would be as a result of its dependency "**Last stock balance recorded on logistics tools (without correcting errors)**."

The overall findings show that inventory management practices have a high relationship with emergency obstetric drug availability.

4.5. Challenges affect inventory management of emergency obstetric drugs in public

Respondents reported many challenges that particularly hinder supply chain performance and inventory management practices. Below are some of the most common ones highlighted in the survey:

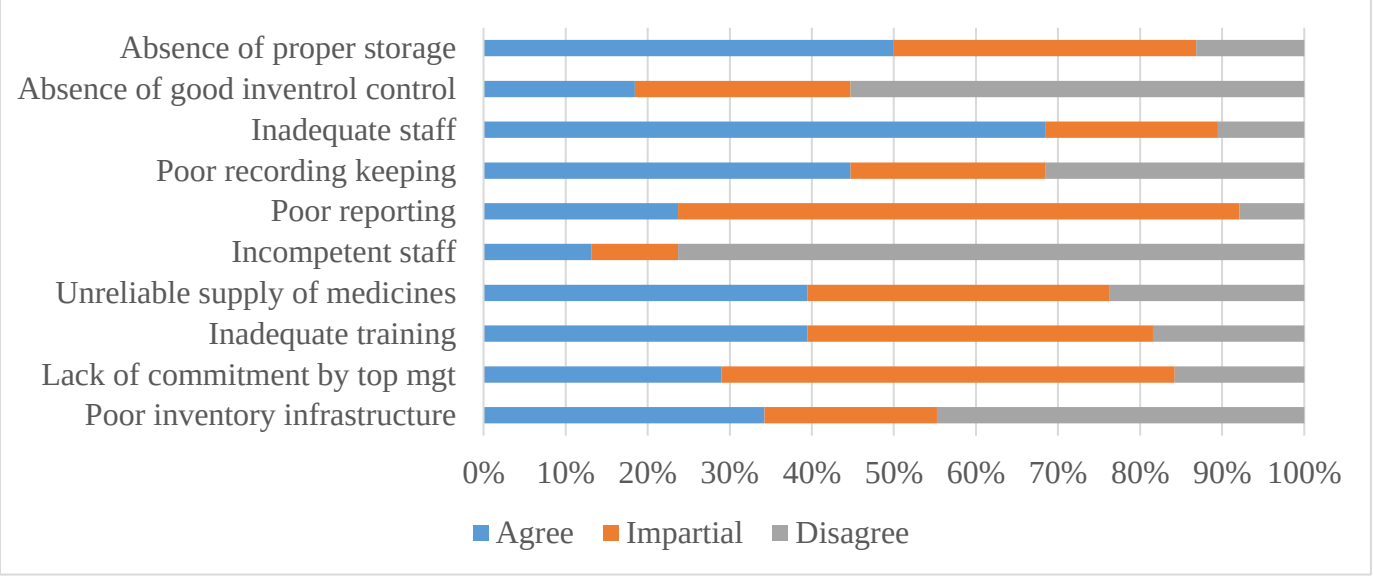


Figure 8: Challenges affecting inventory management of emergency obstetric drugs in public hospitals

Figure 6 shows that incompetent Staff, Poor inventory infrastructure, and absence of good inventory control are not among the challenges. However, about 76%,45%, and 55% of respondents deny the fact that is among challenges of inventory management practices. Respectively.

Inadequate Staff, absence of proper storage, and poor recording keeping are challenges where more respondents agree, 68%, 50%, and 46%, respectively.

4.7 Key informants interview

In addition to quantitative findings, a qualitative component of the research seemed to be best suited to uncover views, attitudes, beliefs, and experiences in inventory management practices and EmOb drugs availability. Therefore, an interview was conducted with nine pharmacists and seven hospital administrators. The themes being researched were: ordering frequency, inventory control models, suitability of the inventory control models in use, causes of inaccurate stock records, essential logistical data for decision making, and the measures applied in preventing stockouts. Additionally, the key informants were asked to highlight the challenges that affect inventory management as described by the key informants summarized in the table below.

4.7.1 Inventory Management Practices

Ordering frequency for EmOb medicines was done monthly. The forced order system was the most predominantly inventory control model (13, 87.5%) which was preferred due to its ability to prevent stockouts and logistical viability. Bin cards (14, 87.5%) and electronic inventory management tools (16, 100%) were the Stock keeping records mostly preferred. The foremost causes of inaccurate stock records were: inadequate Staff (15, 93.75%) and inadequate training (8, 50%). The quantity dispensed, end month physical count, and commodities expiring within the next six months were essential logistical data for the key informants' decision-making. The most common measures to prevent stockouts were updating stock-keeping records (12, 75%) and regular stock counts (14, 87.5%).

Table 4. 9: Inventory Management Practices of Key informants (n=16)

Variable	Category	Frequency
Ordering frequency	Monthly	16 (100%)
Inventory control model	Forced order system	13(87.5%)
	Continuous review system	0 (00%)
	Standard system	3 (12.5%)
Suitability of the used inventory control model	Avoids stock-outs	6 (37.5%)
	Avoids overstocking	7 (43.75)
	Avoids expiries	3 (18.75%)

Stock keeping records used	Logistically viable	12 (75%)
	Guarantees sufficient supplies	5 (31.25%)
	Bin cards	14(87.5%)
	Electronic management information system (e-LMIS).	16 (100%)
Causes of inaccurate stock records	Staff turnover	6 (37.5%)
	Inadequate training	8 (50%)
	Inadequate supervision	3 (18.75%)
	Inadequate staff	15 (93.75%)
	Bad attitude	1 (6.25%)
	Lack of computerized inventory management system	1 (6.25%)
	Demotivated staff	4(25%)
	Oversight	2 (12.5%)
	Failure to do Stock takes	0 (0.0%)
Essential data used for decision making	Beginning balance	10(62.5%)
	Quantity received	13 (81.25%)
	Quantity dispensed	16 (100%)
	End month physical count	14 (%)
	Losses and adjustments	2 (12.5%)
	Commodities expiring in less than six months	3 (18.75%)
	Quantity requested for resupply	4 (25%)
Measures put in place to prevent stock-outs	Regular stock counts	14 (87.5%)
	Use of consumption data	8 (50%)
	Use of buffer stock	9 (56.25%)
	Updating stock keeping records	12(75%)
	Store security	0 (0%)
	Information sharing 3 (18.75%)	
	Use of Electronic management information system (e-LMIS)	7 (43.75%)

4.7.2 Suggestions to Improve Inventory Management

The respondents made recommendations that can improve inventory management within health supply chain management. **(Table).** Other suggestions included hiring more health supply chain personnel (13, 81.25 %t) and motivating health supply chain personnel (14, 87.5 %).

Table 4.10: Recommendations for improving Inventory Management (n=16)

Recommendation	Category	Frequency
Recruit more Pharmaceutical Staff	Yes	13(81.25%)
	No	3(18.75%)
Continuous mentorship and supervision	Yes	9(56.25%)
	No	6(37.5%)
Upgrade E-LMIS	Yes	10(62.5%)
	No	6(37.5%)
Organize regular training	Yes	12(75%)
on inventory management	No	4(25%)
Motivating supply chain staff	Yes	14(87.5%)
	No	2(12.5%)
Improve communication and		
collaboration with suppliers and Partners	Yes	9(56.25%)
	No	6(37.5%)

CHAPTER FIVE: DISCUSSIONS, CONCLUSIONS, AND RECOMMENDATIONS

5.1 Introduction

The following chapter reviews the study's key findings within the framework of current literature. Based on the research findings, conclusions and recommendations have been underscored for policy, practice, and further research.

5.2 Discussions

Ensuring the continuous provision of emergency obstetric drugs and other medical supplies is critical for reducing maternal mortality and improving women's health, mainly in developing countries. This study focused on assessing the influence of inventory management practices on the availability of emergency obstetric drugs due to their life-saving function during maternal complications and the scarcity of research on this topic. However, because the procurement and distribution systems are similar, the findings are most likely to apply to other essential medicines and medical supplies in Rwanda's public hospitals in the Southern Province. Proper inventory management practices are the heart of health supply chain management performance. However, this aspect has received little attention, particularly in developing countries, which, ironically, have a medicine shortage. For example, because oxytocin was unavailable in one of Rwanda's rural health facilities, a nurse performed episiotomies on mothers with prolonged labor and fetal distress. (12). In general, emergency obstetric drug inventory management is intended to assure the availability of medical supplies with the specific goals of maintaining the highest level of maternal health care, reducing associated costs owing to wastage, and maintaining stock levels. It also ensures that the correct products are available in sufficient quantities, at the right time, and at a reasonable price. Inventory management practices such as using the Min-Max inventory control system, formulas for determining quantities to order, and the use of stock records in medical are key determinants in avoiding stockouts of emergency obstetric medicines on the one hand and minimizing expirations on the other. Aside from hospital pharmacists, the majority of the respondents were healthcare administrative officers.

Respondents' work experience ranged from zero to five years. This indicates that these health workers were newly hired and had only worked for a short period of time.

In the public hospitals of the Southern province of Rwanda, results on three identified inventory management practices separately show that about 85% agree that the use of an inventory control system has reduced the Stockout rate. Forced ordering Max-Min inventory control system (70%) was the most predominant inventory control model, whereas the standard version Max-Min inventory control system was the least preferred (0%). Similarly, a study in Nyamira County, Kenya, revealed that the forced re-ordering model was preferred because orders were only placed once at the end of the review period, it helped prevent stockouts and was logistically feasible. (20).

In addition, 79% of respondents agree that formula in the Determination of quantities to order had reduced unusable to usable stock ratio and increased order fill rate. These findings show that combining consumption patterns with stock on hand, the morbidity data concept, and quantities generated automatically by the e-LMIS based on consumption patterns as forecasting methods contributed more to the availability of emergency obstetric drugs in Rwandan public hospitals. According to MSH, minimum-maximum and consumption-based are two simple and useful formulas to determine quantity to order than more sophisticated mathematical concepts like economic order quantity and demand exponential smoothing (22). However, due to problems accessing facilities and order time uncertainty, Nepal's Ministry of Health implemented the forced order system, rendering the continuous review approach impracticable. (17). On the other hand, scheduled inventory control is suitable in a landlocked country like Rwanda, where all medical supplies are imported.

Stock cards and electronic inventory management software were present. A study conducted in Uganda discovered that having accurate stock cards for each Stock Keeping Unit was critical in assessing stock levels and condition. (24)

Regarding the availability status, the study unveiled that 18 months ago and the day of the visit, there have not been Stock out of oxytocin in 60% (n=10) in the public hospitals. This situation revealed that oxytocin injection is currently available in many LMICs, as the study conducted in Malawi reported that oxytocin was available in health facilities (25). On the other hand, magnesium sulfate injection is the one that faced more days of both Stockout and overstock, and Stockout ranged between 16 days (2.96%) and 96 days (17.7%) in the last eighteen months. The above scenario can be explained by the fact that health care practitioners are reluctant to utilize magnesium sulfate because of its complexity of administration and unfounded fear of side effects. The similar reason was given in a study conducted in two North Karnataka districts in India.(26). Therefore, low demand and use among health providers can have a more systemic impact on its stock levels.

From the findings of this study, a high overstocking level of emergency obstetric drugs found, and must be viewed in the context of Rwanda's health system and the organization of its health supply chain management. Rwanda Medical Supply Ltd is the largest supplier of emergency obstetric drugs to public health facilities. However, some batches may be supplied under the MCCH program and delivered to public health facilities free of charge, while others may be purchased when there is a shortage of MCCH products.

An attempt to assess the extent to which logistics tools are updated would vary along with the outcome variable *"Drugs availability in the hospitals" with* a p-value =0,000 < 0.05, It is evident that current inventory management practices and the availability of emergency obstetric drugs in Rwanda's public hospitals in the South Province have strong relationship. In a study conducted in Bungoma County, Kenya, the above association was discovered. (1)

The study unveiled that inadequate Staff (68%) was the main challenge in pharmaceutical inventory management; the same issue has been found in the study done in Cape Town, South Africa, where research found that inventory management gaps are caused by human resource challenges on the one hand, and undefined procedures and a lack of systematic stock monitoring on the other. (16)

To overcome these challenges, respondents recommended recruiting more health supply chain staff (81.25%) and motivating health supply chain staff (87.5%) should improve inventory management practices so that emergency obstetric drugs are always available in hospitals.

5.3 Conclusion

The objectives of this study were to establish the relationship between inventory management practices and the availability of emergency obstetric drugs within public hospitals in the Southern province of Rwanda. Use of inventory control system, minimum-maximum and consumption-based formulas, and Stock keeping records influenced the availability of emergency obstetric drugs in Rwanda's public health hospitals, and the Stockout was relatively low and stock wastage. Proper inventory management practices are significantly influential in ensuring the continuous availability of emergency obstetric drugs, particularly in public health facilities. This will decrease frequent stockouts and the risk of medicines expiring. A number of challenges with drug inventory management were also observed. If addressed appropriately, this will assure proper inventory management practices and hence pharmaceutical availability. Pharmaceutical supply chain management personnel, in particular, need to be more trained in medicine management than other healthcare personnel.

5.4 Recommendations

From this study, recommendations are formulated to improve the availability emergency obstetric drugs:

-Ensuring timely recording and entries on logistics tools will contribute to perform well inventory management practices.

- Disseminate documented SOPs on inventory management practices in healthcare facilities.

-Recruit and motivate more health supply chain personnel within health facilities

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