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A Qualitative Assessment of Health Commodities Forecasting and Quantification at Namibia Medical Stores (NMS)

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Abstract

Background
Healthcare supply chain is dependent on the accuracy of the forecasting and quantification that directly influences the access to necessary medicines. This paper evaluated the existing forecasting and quantification practices used at the Central Medical Stores (CMS) in Namibia to avail the strengths, weaknesses and areas of improvement.

Methods
The qualitative case study design was employed. The semi-structured interviews with 15 purposely selected key stakeholders who were engaged in health commodity management at CMS were used to gather the data. The interviews were complemented by documentary analysis of the relevant reports and guidelines. Atlas.ti software was used in the thematic analysis.

Results
The research established that CMS uses a two-way strategy, which involves the use of a qualitative and quantitative forecasting model. Quantitative models comprise analysis of safety stock, analysis of historical consumption and analysis of demand forecasting models as well as inventory simulation models. Qualitative approaches are based on the subject opinion of the expert, the Delphi approach, and the contributions of the vendor/supplier. The main informational input that drives these techniques are historical data, purchase lead times, population health, and the health facility inventory levels.

Conclusions
Although CMS is built on a well-organized foundation of forecasting, the use of historical data and manual and Excel-based forecasting present bias and restrict the accuracy and responsiveness. As a way of enhancing the quantification processes, it is recommended that CMS integrate advanced analytical tools, automate data workflows, and enhance staff capacity in quantitative forecasting techniques.

Keywords: Health Commodities, Forecasting Methods, Quantification, Supply Chain Management, Central Medical Stores, Namibia

Introduction

The provision of essential medicines and healthcare supplies is a cornerstone of effective health systems, directly influencing care quality and health outcomes. At the heart of this provision lies the public health supply chain, where the Central Medical Stores (CMS) in Namibia holds a pivotal role. The CMS is responsible for ensuring that healthcare facilities nationwide receive necessary medical products in correct quantities and in a timely manner (Ambambi & Waiganjo, 2024). However, the efficiency of this mandate is heavily dependent on the accuracy of forecasting and quantification processes.

Forecasting in health commodity management involves predicting future demand, while quantification determines the precise quantities of products required to meet that demand over a specific period (Choi et al., 2013). Inaccurate processes can lead to critical stock-outs or costly overstocking, both of which impede healthcare delivery and strain limited resources (Yadav, 2015). In Namibia, concerns have been raised regarding the precision of these processes at the CMS, potentially contributing to supply inconsistencies (Ekandjo, 2022).

Globally, health commodity forecasting is recognized as a complex, long-term endeavor fraught with uncertainty, especially for items like vaccines (Schaefer et al., 2020). The economic and health costs of poor forecasting are significant, potentially limiting access to essential commodities and risking the infiltration of substandard medicines into the system (Webb, 2014). While various forecasting models exist from quantitative techniques like time-series analysis to qualitative methods like expert judgment their effectiveness is context-dependent (Sarley et al., 2010; Tiye & Gudeta, 2018).

This study, therefore, sought to assess the specific suite of forecasting and quantification methods currently in use at Namibia's CMS. By mapping these methods and their informational inputs, the research provides a foundational analysis to inform strategies for enhancing the accuracy and reliability of the medical supply chain, ultimately supporting improved health service delivery in Namibia (Waiganjo et al., 2020).

Objective

To assess the current forecasting and quantification methods employed by the Central Medical Stores.

Methods

Study Design

This study employed a qualitative, exploratory case study design. A case study approach was deemed most appropriate as it allows for an in-depth, holistic investigation of a contemporary phenomenon, forecasting and quantification methods within its real-life context at the CMS (Creswell & Creswell, 2022). The design facilitated a detailed examination of the processes, tools, and stakeholder experiences that constitute the forecasting environment.

Study Setting and Population

The study was conducted at the Central Medical Stores of Namibia, the national-level hub responsible for the procurement, storage, and distribution of essential medicines and health commodities to public health facilities across

the country. The study population comprised key stakeholders directly involved in or influencing the forecasting and quantification processes at CMS. This included personnel from the procurement and distribution units, the forecasting and quantification department, pharmacists, logistics officers, and quality controllers.

Sampling and Data Collection

A purposive sampling technique was used to select 15 participants who could provide rich, information-laden insights based on their roles and experience. Sample size determination aligned with qualitative research norms, where saturation—the point at which no new thematic information is observed is key (Creswell & Creswell, 2022). Data saturation was achieved with the 15 participants.

Primary data were collected through semi-structured, in-depth interviews conducted using an interview guide. The guide contained open-ended questions exploring the types of forecasting and quantification methods used, the sources of information informing these methods, perceived effectiveness, and associated challenges. All interviews were audio-recorded with consent and later transcribed verbatim. Secondary data were collected through documentary analysis of relevant CMS reports, standard operating procedures (SOPs), quantification guidelines, and past forecasting records to triangulate and contextualize interview findings.

Data Analysis

Thematic analysis, following the six-phase framework by Braun and Clarke (2012), was used to analyze the qualitative data. This process was facilitated by ATLAS.ti software (version 22). The phases included:

1. Familiarization: Repeated reading of transcripts and documents.
2. Generating initial codes: Systematic coding of interesting features across the entire dataset.
3. Searching for themes: Collating codes into potential themes.
4. Reviewing themes: Checking themes against coded extracts and the entire dataset to ensure coherence.
5. Defining and naming themes: Refining the essence of each theme.
6. Producing the report: Selecting compelling extracts and relating the analysis to the research objective.

Ethical Considerations

Ethical approval for the study was obtained from the Namibia University of Science and Technology (NUST) Institutional Review Board and the Ministry of Health and Social Services (MoHSS) research committee. Written informed consent was secured from all participants before interviews. Confidentiality was maintained by using participant codes (e.g., R1, R2) instead of names in transcripts and reports, and all data were stored securely.

Results

Demographics of Participants

A total of 15 participants were enrolled. The majority were male (n=11), and professional roles included pharmacists (n=7), procurement officers (n=4), logistics officers/managers (n=3), and a quality controller (n=1). Experience levels varied, with the majority having 1-5 years of experience (n=7), followed by 6-10 years (n=4), and over 10 years (n=3). All participants demonstrated clear knowledge of forecasting and quantification processes at CMS.

Information Inputs for Forecasting and Quantification

Participants described several critical streams of information that feed into the forecasting and quantification cycle:

1. Historical Data: Past consumption, procurement, and distribution data were the most frequently cited input. As one respondent noted, "*Historical data aids in identifying potential supply chain challenges and bottlenecks that may have occurred in the past… allowing for proactive measures*" (R3).
2. Procurement Lead Times: The time required to procure items was a key factor in determining safety stock levels and reorder points to prevent stock-outs during procurement delays.
3. Population Health Statistics: Data on disease prevalence, demographics, and morbidity were used to anticipate demand for specific commodities, such as vaccines or chronic disease medications.
4. Health Facility Stock Levels: Reports on stock levels at health facilities provided ground-truth data on consumption and helped identify usage patterns and potential stock-outs at the service delivery point.
5. Expert Opinion and Government Policies: Insights from experienced personnel and directives from national health policies and treatment guidelines shaped demand assumptions, especially for new programs or policy changes.

Forecasting and Quantification Models in Use

The analysis revealed that CMS employs a combination of quantitative and qualitative models, which are summarized in Table 1.

Table 1: Forecasting and Quantification Models at CMS

Quantitative Models	**Qualitative Models**
ABC Analysis	Vendor/Supplier Input
Safety Stock Calculations	Experts Opinion
Historical Consumption Data	Delphi Method
Demand Forecasting Models	
Inventory Simulation Models	
Times Series Analysis	

Quantitative Models

Results in this study show that in ABC analysis, Items are categorized by value and consumption volume (A=high value/low consumption, B=moderate, C=low value/high consumption) to prioritize forecasting and inventory control efforts. Class A items received the most meticulous forecasting attention. Models considered lead time and demand variability to calculate buffer stock aimed at preventing stock-outs due to unexpected demand spikes or procurement delays. Historical consumption data was the cornerstone of most quantitative forecasting, used to project future demand based on past trends, though participants acknowledged its limitations if past data reflected stock-outs

rather than true demand. Further, Basic statistical models and simulations were reportedly used to project needs and test different inventory scenarios, though their use was not deeply institutionalized.

Qualitative Models

Results show that Expert Opinion was used. The judgment and experience of senior pharmacists and procurement officers were heavily relied upon, especially for new products or when data was lacking. Information from suppliers regarding production capacity, market trends, and lead times was incorporated into procurement planning. Delphi Method, a structured process of gathering anonymous expert opinions to reach a consensus forecast was mentioned, though its use appeared limited to specific, complex forecasting exercises. A significant finding was the reported under-utilization of available technology. Despite having access to the SYSPRO enterprise resource planning system, forecasting often reverted to manual calculations in Excel spreadsheets.

Discussion

This study provided a systematic assessment of the forecasting and quantification methods at Namibia's CMS, revealing a hybrid system that blends structured quantitative techniques with essential qualitative insights. The use of ABC analysis and safety stock calculations aligns with established inventory management principles for prioritizing resources and mitigating uncertainty (Matowe, 2009; MOH Philippines, 2015). The reliance on historical consumption data is a standard practice; however, as noted by respondents and supported in literature, this becomes problematic if historical data is inaccurate or reflects periods of stock-out rather than true consumption (Agrawal et al., 2016; Berenguer et al., 2016).

The coexistence of qualitative methods like expert opinion is not a weakness but a necessity in complex, data-poor environments. Expert judgment helps navigate uncertainty and incorporate tacit knowledge that quantitative models may miss (Woodburn, 2013). However, the challenge lies in systematically integrating these qualitative insights with quantitative data to reduce bias.

The core issue identified is not the absence of methods but their execution and technological support. The dependence on manual Excel-based processes, as reported, introduces significant risks of error, limits the ability to handle complex analyses, and hinders scalability (Tiye & Gudeta, 2018). This finding echoes broader challenges in low-resource settings where supply chain management systems are often under-exploited (Jira & Toffel, 2013). The under-utilization of the SYSPRO system's forecasting capabilities represents a critical gap between technological investment and operational practice.

Furthermore, the informational inputs, while comprehensive in scope, face issues of reliability and timeliness, particularly data from health facilities. This affects the quality of all downstream forecasting models. The study's findings affirm the importance of strengthening foundational data quality and flow, a prerequisite for advanced forecasting, as emphasized in global health supply chain literature (Steele et al., 2019).

Conclusion

This assessment concludes that the Central Medical Stores of Namibia utilizes a recognized mix of forecasting and quantification methods, grounded in both data analysis and expert judgment. However, the effectiveness of these methods is constrained by an over-reliance on manual data processing, incomplete use of available technological systems, and potential gaps in the reliability of source data.

To enhance forecasting for improved quantification, CMS should prioritize technological integration by fully leveraging its SYSPRO system's forecasting modules to automate calculations and improve accuracy. Concurrently, capacity building is essential to equip staff with the skills to use these advanced tools and interpret complex models. Finally, strengthening the data pipeline ensuring accurate, timely data from health facilities—is the fundamental step upon which all improved forecasting depends. Implementing these recommendations will move CMS from a reactive, historically dependent forecasting model toward a more proactive, data-driven, and resilient supply chain operation.

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Author's Contributions

Ruusa Megameno Ambambi: Execution of the experimental protocols, data analysis, and preparation of the original manuscript draft.

Dr. Moses Waiganjo: Provided academic oversight and scientific guidance throughout the research and manuscript development, synthesizing contributions from all authors into a cohesive narrative. His expertise in research write-up ensured clarity and precision in communicating our research methods, results, and conclusions.

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