



Effect of Inventory Management Practices on Effective Service Delivery in BUFMAR, Kigali City, Rwanda

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Abstract: Effective demand forecasting is important for medical supply organisations because accurate prediction of product requirements supports procurement planning, inventory availability, and timely service delivery. This study focused on assessing the effect of demand forecasting accuracy on effective service delivery in BUFMAR, Kigali City, Rwanda. The study adopted a mixed-method approach using descriptive and explanatory designs. The target population comprised 180 BUFMAR staff and customers, from whom 124 respondents were selected through stratified sampling. Data were collected using questionnaires, interviews, and documentary review. Quantitative data were analysed using descriptive statistics, Pearson correlation, and multiple linear regression, while qualitative information was used to complement the quantitative findings. The results showed that demand forecasting accuracy was implemented at a high level, with an overall mean of 3.48 and a standard deviation of 0.71. Pearson correlation analysis showed a positive and statistically significant relationship between demand forecasting accuracy and effective service delivery ($r = 0.630, p < .01$). The regression analysis reported a positive and statistically significant coefficient for demand forecasting accuracy ($B = 0.242, \beta = 0.164, t = 2.400, p = .018$). The null hypothesis was therefore rejected. The finding indicates that more accurate demand forecasting contributes to improved service delivery by supporting better anticipation of customer requirements, procurement planning, product availability, and reduction of stock-outs and overstocking. The manuscript concludes that strengthening forecasting systems is important for improving effective service delivery at BUFMAR and recommends regular updating of forecasting tools, integration of historical consumption and current market information, and stronger coordination among procurement, warehouse, sales, and management functions.

Keywords: Demand forecasting accuracy; effective service delivery; medical supplies; inventory management; BUFMAR.

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1. Introduction

Demand forecasting is an important function in healthcare supply chains because medical supply organisations must anticipate future requirements while managing uncertainty in consumption, seasonality, market changes, and health-service demand. Accurate forecasts provide a basis for determining what quantities of products are required, when they are required, and how procurement and replenishment

should be organised. In healthcare settings, forecasting accuracy is particularly important because shortages of essential products can interrupt service delivery, while excessive procurement can increase holding costs, wastage, and expiry risks (Ivanov & Dolgui, 2022; Gunasekaran et al., 2021).

Modern supply chains increasingly use historical consumption data, forecasting tools, information systems, and analytical techniques to improve demand prediction. Adebayo and Okeke (2020) reported that accurate demand forecasting can enhance procurement decisions and reduce supply disruptions in medical supply organisations.

Similarly, Mensah and Boateng (2021) found that effective forecasting mechanisms improve efficiency and responsiveness in healthcare supply chains. The use of digital technologies and advanced analytics has also created opportunities for organisations to update forecasts more frequently and respond to changing demand conditions (Khan et al., 2023; Aldahmani et al., 2024). These developments demonstrate that forecasting accuracy is not simply a planning activity but an important operational mechanism for supporting service delivery.

In healthcare supply chains in developing countries, demand forecasting is often affected by incomplete consumption information, changing disease patterns, supplier uncertainty, limited information-system integration, and weaknesses in forecasting capacity. Such conditions may create differences between actual demand and procurement quantities. When forecasts are inaccurate, organisations may experience stock-outs, emergency procurement, excess inventory, delayed deliveries, or product expiry. Conversely, accurate forecasting can improve the alignment between demand, procurement, inventory availability, and customer requirements (Rahman & Zainuddin, 2021; Thompson, 2024).

In Rwanda, effective management of medical supplies is important for maintaining reliable health services. The Ministry of Health (2022) and Rwanda Biomedical Centre (2022) have emphasised the importance of supply-chain information, availability of medical commodities, and effective logistics management. Evidence from Rwanda also indicates that inventory information and replenishment processes remain important operational concerns. Mvuyekure et al. (2024) reported that delays in replenishment can be associated with inaccurate demand forecasting, supplier lead times, and wider supply-chain disruptions. These challenges make demand forecasting accuracy an important area for empirical examination within Rwandan medical supply organisations.

BUFMAR is a medical supply organisation operating within this environment and depends on effective forecasting to anticipate customer requirements and guide procurement and distribution decisions. The thesis reports that essential medicine availability was 63%, order fulfilment was 55%, inventory record discrepancies exceeded 20% at some peripheral distribution sites, and approximately 40% of procurement orders experienced significant replenishment delays (BUFMAR, 2023; Ministry of Health, 2022; Mvuyekure et al., 2024). These indicators suggest that there are challenges in achieving consistent supply responsiveness. However, the existence of service-delivery challenges does not by itself demonstrate the extent to which demand forecasting accuracy contributes to service delivery performance.

Although previous studies have examined forecasting accuracy and supply-chain performance, limited context-specific empirical evidence has focused on the relationship between demand forecasting accuracy and effective service delivery within BUFMAR in Kigali City. Much of the available literature examines healthcare supply chains generally or organisations in other national settings. This creates a contextual gap concerning how forecasting accuracy contributes to service delivery in a Rwandan medical supply organisation. The present manuscript therefore concentrates exclusively on the effect of demand forecasting accuracy on effective service delivery at BUFMAR.

1.1 Statement of the Problem

Effective service delivery in medical supply organisations depends partly on the ability to anticipate customer requirements and make procurement decisions before shortages occur. Demand forecasting provides information that can guide procurement quantities, replenishment timing, inventory planning, and distribution. When forecasting is accurate, organisations can better align supply with expected demand, reduce the likelihood of stock-outs and overstocking, and improve the availability and responsiveness of medical products (Adebayo & Okeke, 2020; Mensah & Boateng, 2021).

Despite the importance of forecasting, healthcare supply chains may experience difficulties in predicting demand because consumption patterns change, forecasting tools may not be updated regularly, and information from different operational units may not be fully integrated. These weaknesses can result in inappropriate procurement decisions, excess inventory, stock shortages, emergency orders, and delays in fulfilling customer requirements. In Rwanda, reported inventory and replenishment challenges include inventory record discrepancies exceeding 20% and significant delays affecting approximately 40% of procurement orders (Ministry of Health, 2022; Mvuyekure et al., 2024). Such conditions can negatively affect the ability of medical supply organisations to provide reliable and timely services.

The situation is relevant to BUFMAR because the organisation serves healthcare customers whose requirements depend on the timely availability of medical products. The thesis reports an essential medicine availability rate of 63% and an order fulfilment rate of 55%, suggesting that the organisation has faced challenges in maintaining consistent supply responsiveness (BUFMAR, 2023). Although these indicators demonstrate a service-delivery concern, they do not independently establish whether the accuracy of demand forecasting significantly contributes to service delivery. There was therefore a need to empirically assess the relationship

between demand forecasting accuracy and effective service delivery at BUFMAR.

The study addressed this gap by focusing exclusively on demand forecasting accuracy as the independent variable and effective service delivery as the dependent variable. The assessment considered forecasting practices such as the use of historical sales information, adjustment of forecasts for seasonal and market changes, analysis of forecasting errors, updating of forecasting tools, communication of forecasts, prevention of stock-outs and overstocking, and use of forecasts to guide procurement and production planning. The study therefore sought to establish whether more accurate demand forecasting contributes significantly to effective service delivery at BUFMAR in Kigali City, Rwanda.

1.2 Specific Objective

- i. To assess the effect of demand forecasting accuracy on effective service delivery in BUFMAR, Kigali City, Rwanda.

1.3 Research Hypothesis

H01: Demand forecasting accuracy has no significant effect on effective service delivery in BUFMAR, Kigali City, Rwanda.

2. Literature Review

This section reviews the key concepts underpinning the study, with particular emphasis on Inventory Management Practices, demand forecasting accuracy and effective service delivery in medical supply organisations. The review defines demand forecasting accuracy, explains its major features and dimensions, and examines how accurate forecasting can contribute to effective service delivery. Since the study focuses on one specific objective, the discussion is limited to the relationship between demand forecasting accuracy and effective service delivery in BUFMAR, Kigali City, Rwanda.

2.1.1. Inventory Management Practices

Inventory management practices refer to the systematic processes and activities used by organisations to plan, control, monitor, and maintain the availability of inventory from procurement to final distribution. These practices are intended to ensure that organisations maintain appropriate inventory levels, minimise unnecessary holding costs, reduce stock-outs and wastage, and support the timely provision of products and services. In medical supply

organisations, effective inventory management is particularly important because the availability of medicines and other healthcare commodities can directly influence the continuity and quality of healthcare services. George and Elrashid (2023) found that inventory level control and demand forecasting significantly influence the performance of pharmaceutical supply chains in hospital pharmacies. Similarly, Akande and Enyejo (2024) demonstrated that predictive analysis can improve inventory management and demand forecasting.

Inventory management practices involve several activities, including demand forecasting, inventory level control, inventory tracking, storage and handling, procurement, and replenishment. Although these activities are interconnected, demand forecasting accuracy is particularly important because it provides information that guides subsequent inventory decisions. Accurate forecasts enable organisations to estimate future requirements and determine appropriate quantities and timing for procurement and replenishment. In contrast, inaccurate forecasts may result in either insufficient inventory, leading to stock-outs, or excessive inventory, increasing holding costs and the risk of product expiry. George and Elrashid (2023) emphasised the importance of accurate forecasting in improving medicine availability and pharmaceutical supply-chain efficiency, while Akande and Enyejo (2024) demonstrated that predictive forecasting approaches can support better inventory decisions.

The effectiveness of inventory management has also been influenced by the increasing use of information and digital technologies. Carpitella and Izquierdo (2025) highlighted the contribution of digital technologies to real-time inventory monitoring and decision-making, while Akande and Enyejo (2024) showed that analytical technologies can strengthen forecasting and inventory planning. However, technological systems alone may not guarantee effective inventory management. The quality of data, availability of relevant information, staff competence, and organisational capacity to interpret and apply information are also important. Therefore, effective inventory management requires an integrated approach in which reliable demand information is transformed into appropriate procurement, replenishment, and inventory decisions.

In medical supply organisations, inventory management is also affected by storage conditions, procurement lead times, supplier reliability, and the availability of healthcare commodities. The World Health Organization (2023) emphasised the importance of appropriate storage and handling practices in maintaining the quality and safety of medical products. Mvuyekure et al. (2024) further noted that Rwanda's dependence on imported medical commodities may contribute to extended procurement

periods and challenges in commodity availability. Under such circumstances, accurate demand forecasting becomes particularly important because procurement decisions must consider both expected demand and the time required to obtain medical commodities

2.1.2 Demand Forecasting Accuracy

Demand forecasting accuracy refers to the extent to which forecasted demand corresponds with actual customer or consumer demand, thereby enabling organisations to make appropriate decisions regarding procurement, inventory planning, and replenishment. In healthcare supply chains, accurate demand forecasting is particularly important because errors in estimating demand may result in shortages, excess inventory, product expiry, increased operational costs, and interruptions in service delivery. Accurate forecasting enables medical supply organisations to anticipate customer requirements and align procurement and inventory decisions with expected demand. Kagalwala et al. (2025) noted that accurate forecasting reduces uncertainty and supports better resource allocation, while Queiroz et al. (2022) emphasized that effective forecasting strengthens supply chain resilience and responsiveness when demand conditions fluctuate.

The effectiveness of demand forecasting depends on several factors, including the quality and availability of data, the forecasting methods applied, technological capacity, and the organisation's ability to interpret and use forecast information in decision-making. Historical consumption information is particularly important because it provides evidence of previous demand patterns that can guide future forecasts. However, forecasting should also consider changes in market conditions, seasonal variations, and emerging demand patterns. Aldahmani et al. (2024) demonstrated that advanced technologies, including artificial intelligence, machine learning, and data analytics, can improve forecasting accuracy by identifying complex demand patterns that may not be easily detected through conventional approaches. Similarly, Kagalwala et al. (2025) found that technology-based forecasting can improve inventory management and reduce uncertainty surrounding future demand.

Although technological systems can strengthen forecasting accuracy, technology alone does not guarantee reliable forecasts. The quality of the information entered into the forecasting system and the ability of employees to interpret and apply the resulting information remain important. Kagalwala et al. (2025) emphasized that technological forecasting should be supported by reliable data and appropriate decision-making capacity. Aldahmani et al. (2024) similarly highlighted the contribution of advanced analytical technologies to forecasting improvement. These findings suggest that forecasting accuracy results from the

interaction of appropriate technology, reliable information, and organisational capacity rather than from the forecasting model alone.

In medical supply organisations, forecasting accuracy has direct implications for the continuity and responsiveness of supply. When demand is underestimated, organisations may experience stock-outs and delays in fulfilling customer requirements. Conversely, when demand is overestimated, organisations may accumulate unnecessary inventory, increasing holding costs and the risk of product expiry. Queiroz et al. (2022) found that accurate forecasting contributes to supply chain resilience and responsiveness by enabling organisations to respond more effectively to fluctuations in demand. Kagalwala et al. (2025) similarly associated accurate forecasting with improved decision-making and resource allocation. Therefore, demand forecasting accuracy is an important mechanism through which medical supply organisations can align supply with actual customer requirements.

The reviewed literature also indicates that the effectiveness of forecasting can be influenced by the organisational context in which it is applied. Many existing studies have been conducted in organisations with relatively developed information systems, reliable data infrastructures, and adequate technical expertise. Queiroz et al. (2022) noted that forecasting accuracy depends partly on information availability and organisational capacity to undertake effective forecasting. In developing-country healthcare supply chains, limitations in information systems, data availability, technological capacity, and human resources may affect the ability of organisations to produce and use accurate forecasts.

In Rwanda, the importance of accurate forecasting is particularly relevant because medical supply organisations operate within a supply environment affected by procurement and replenishment challenges. Mvuyekure et al. (2024) noted that dependence on imported medical commodities can contribute to extended procurement periods and challenges in maintaining commodity availability. Under such conditions, accurate demand forecasting becomes important because procurement decisions need to be made sufficiently in advance to account for supply lead times. Accurate forecasts can therefore assist medical supply organisations in determining appropriate procurement quantities and timing, thereby reducing the likelihood of shortages and supporting continuity of service delivery.

Despite the growing literature on demand forecasting, there remains limited empirical evidence on how forecasting accuracy affects service delivery in medical purchasing and distribution organisations in developing countries. Mutambudzi et al. (2022) observed that much of the

existing research has focused on hospitals, pharmacies, and general healthcare supply chains, with comparatively limited attention to organisations responsible for procuring and distributing medical supplies to different healthcare facilities. This creates a contextual gap concerning organisations such as BUFMAR, where forecasting decisions can influence procurement, inventory availability, order fulfilment, and ultimately the delivery of services to customers.

2.1.3. Effective Service Delivery

Effective service delivery refers to the extent to which an organisation provides services to customers in a timely, reliable, responsive, and efficient manner while meeting their expected requirements. In medical supply organisations, effective service delivery is closely associated with the availability of required products, timely order fulfilment, accuracy of deliveries, responsiveness to customer needs, and continuity of supply. The effectiveness of service delivery is therefore influenced by the organisation's ability to anticipate demand and ensure that the required products are available when and where they are needed.

Demand forecasting accuracy can contribute to effective service delivery by enabling medical supply organisations to anticipate customer requirements and make appropriate procurement and replenishment decisions. When forecasts closely reflect actual demand, organisations can plan the quantities required and schedule procurement activities accordingly. This can reduce the possibility of stock-outs and improve the organisation's ability to fulfil customer orders. Queiroz et al. (2022) emphasized that effective forecasting supports supply-chain responsiveness and resilience, while Kagalwala et al. (2025) associated accurate forecasting with improved resource allocation and decision-making.

In contrast, inaccurate demand forecasts can negatively affect service delivery. Under-forecasting may result in insufficient inventory, stock-outs, delayed order fulfilment, and customer dissatisfaction. Over-forecasting may lead to excess inventory, higher storage costs, and product expiry, particularly for medical commodities with limited shelf lives. Consequently, the accuracy of demand forecasts can influence the organisation's ability to maintain an appropriate balance between product availability and inventory efficiency. This relationship is particularly important in medical supply organisations because service interruptions resulting from unavailable products may affect healthcare facilities and the customers they serve.

The effectiveness of service delivery also depends on the organisation's capacity to translate forecast information into operational decisions. Forecast information must be communicated to relevant departments and incorporated into procurement, inventory planning, and replenishment activities. Aldahmani et al. (2024) demonstrated that technological and analytical capabilities can improve the quality of forecasting information, while Kagalwala et al. (2025) emphasized the importance of using reliable information to support decision-making. Therefore, the contribution of forecasting accuracy to service delivery depends not only on the accuracy of the forecast but also on how effectively the information is used within the organisation.

2.1 Theoretical Perspective

The study was informed by the Bullwhip Effect Theory, which explains how relatively small variations in customer demand can become increasingly amplified as demand information moves upstream through different stages of a supply chain. The theory is associated with the work of Lee, Padmanabhan, and Whang (1997), who identified demand-forecast updating, order batching, price fluctuations, and shortage-related behaviour among the major causes of the bullwhip effect. The phenomenon occurs when changes in actual customer demand result in larger fluctuations in orders and inventory at higher levels of the supply chain. Wang and Disney (2016) further explain that the bullwhip effect is characterised by increasing order variability as orders move upstream from customers to suppliers.

The theory is particularly relevant to demand forecasting accuracy because forecasting is one of the mechanisms through which organisations respond to changes in demand. When forecasts are based on inaccurate, outdated, or incomplete information, organisations may overestimate or underestimate future requirements, resulting in excessive orders, stock accumulation, stock-outs, or delayed replenishment. Conversely, appropriate forecasting methods and reliable demand information can reduce unnecessary demand variability and improve supply-chain coordination. Reiner and Fichtinger (2009) demonstrate that demand forecasting is an important factor in supply-chain performance and that forecasting approaches can influence both demand variability and service levels. Similarly, research on forecasting methods shows that appropriate forecasting approaches can help mitigate the bullwhip effect.

The Bullwhip Effect Theory therefore provides a suitable theoretical foundation for examining the effect of demand forecasting accuracy on effective service delivery at BUFMAR. In medical supply chains, inaccurate demand information can be amplified across procurement,

distribution, and replenishment processes, resulting in either shortages or excessive inventories and consequently affecting the ability to meet customer requirements. Evidence from healthcare supply chains shows that weak information flows and long lead times can intensify the bullwhip effect, causing demand uncertainty to be amplified across different supply-chain levels and increasing the risk of stock-outs or excess inventory. More recent evidence from hospital supply chains also indicates that sharing accurate consumption information can improve forecast accuracy and reduce bullwhip effects. Therefore, the theory supports the argument that improving demand forecasting accuracy can reduce uncertainty, strengthen procurement and replenishment decisions, and ultimately contribute to more reliable and effective service delivery at BUFMAR.

2.2 Empirical Review

Empirical evidence generally indicates that demand forecasting accuracy is associated with improved supply-chain and service outcomes. Merkuryeva, Valberga, and Smirnov (2019) conducted a study on demand forecasting in pharmaceutical supply chains, focusing on the development of an integrated procedure for forecasting product demand and generating purchase orders. The study adopted a case study approach involving pharmaceutical products supplied by a wholesaler to a distribution company in an emerging market. The researchers experimentally compared different forecasting approaches, including the simple moving average, multiple linear regression, and symbolic regression using genetic programming. The results demonstrated that different forecasting approaches produced different levels of forecasting performance and that the selection of an appropriate forecasting method has practical implications for procurement and supply-chain decisions. The study concluded that demand forecasting should be integrated with procurement planning rather than treated as an independent activity. It recommended that pharmaceutical organisations select forecasting approaches according to their demand characteristics and integrate forecasting results into purchase-order and supply-chain planning processes. The study is relevant to the present research because it demonstrates the importance of demand forecasting accuracy in pharmaceutical supply chains; however, its focus was on forecasting methods and purchase-order generation rather than the direct effect of forecasting accuracy on effective service delivery in a Rwandan medical supply organisation.

Zhu et al. (2021) examined demand forecasting in the pharmaceutical industry using supply-chain information and machine-learning techniques. The researchers developed a forecasting framework that incorporated

information from multiple product time series and used machine-learning models to identify demand patterns that may not be captured through traditional forecasting techniques. The study was motivated by the challenge of relying only on historical demand data, particularly where market conditions change and demand is influenced by factors that are difficult to observe directly. The findings showed that incorporating supply-chain information and information from other products can improve demand forecasting, particularly where traditional historical-series approaches are limited. The researchers concluded that pharmaceutical demand forecasting can benefit from combining available supply-chain information with advanced analytical techniques. They recommended that pharmaceutical organisations improve the quality and scope of information used in forecasting and consider advanced forecasting approaches where sufficient data are available. The study provides strong support for the importance of demand forecasting accuracy, but its application of machine learning and cross-product information differs from the present study, which focuses on the effect of demand forecasting accuracy on effective service delivery at BUFMAR.

Ali, Boylan, and Syntetos (2012) investigated the relationship between forecast accuracy and inventory performance under forecast information sharing. The study used an analytical approach and simulation, considering a two-stage supply chain under two conditions: forecast information sharing and no information sharing. The theoretical results were subsequently assessed using a real sales dataset obtained from a major European superstore. The findings showed that improvements in forecast accuracy resulting from information sharing depended on the characteristics of the demand process. More importantly, the researchers found that improvements in forecast accuracy could translate into inventory savings, although the magnitude of the benefits depended on the extent of improvement in forecasting accuracy. The study concluded that forecast accuracy should not be considered independently from the operational consequences of forecasting because improvements in accuracy do not automatically produce equivalent improvements in inventory performance. The authors recommended greater attention to information sharing and the use of forecasting measures that can be linked to operational and inventory outcomes. This study is relevant to the present research because it establishes a relationship between forecasting performance and operational outcomes; however, it was conducted using a two-stage supply-chain model and retail sales data rather than a medical supply organisation in Rwanda.

Theodorou, Spiliotis, and Assimakopoulos (2025) examined the relationship between forecast accuracy and

inventory performance using data from the M5 forecasting competition. The researchers used a large dataset covering more than 7,500 demand series and evaluated 13 forecasting methods under different inventory-control conditions. They conducted simulations using an order-up-to inventory policy and examined different review periods, lead times, target service levels, and demand patterns. The findings showed that the relationship between forecast accuracy and inventory performance was not always strong and depended on product characteristics, inventory policies, lead times, review periods, and the costs associated with holding inventory and lost sales. The researchers concluded that the most accurate forecasting method is not necessarily the method that produces the best operational outcome under every inventory environment. They recommended that organisations evaluate forecasting methods according to their specific operational objectives, inventory policies, product characteristics, and cost structures rather than relying exclusively on conventional forecast-accuracy measures. The study is important to the present research because it demonstrates that forecasting accuracy should ultimately be considered in relation to operational performance. However, it used retail data and simulation rather than empirical evidence from medical supply operations, leaving a contextual gap that the present study addresses by examining demand forecasting accuracy and effective service delivery at BUFMAR.

Petropoulos, Wang, and Disney (2018) examined the inventory performance of different forecasting methods using data from the M3 forecasting competition. The study adopted a rolling simulation approach and evaluated forecasting methods including exponential smoothing, ARIMA, the Theta method, and multiple temporal aggregation approaches under an order-up-to inventory policy with different lead times. The findings showed that forecasting methods based on combinations generally produced superior inventory performance, whereas some individual methods, including naïve, Holt, and Holt-Winters approaches, performed less effectively under the conditions examined. The researchers concluded that forecasting methods should be evaluated not only according to forecast accuracy but also according to their practical utility in inventory management and customer service. They recommended that organisations evaluate forecasting techniques using operational measures such as inventory costs, replenishment variability, and service levels rather than relying solely on forecast-error measures. This study supports the argument that forecasting has implications beyond prediction accuracy and can influence operational performance. Nevertheless, the study relied on simulated inventory environments and industry data rather than primary data from healthcare supply organisations, creating a contextual gap for the present study.

Yani and Aamer examined demand forecasting accuracy in the pharmaceutical supply chain using a machine-learning approach. The study sought to determine the applicability of machine-learning algorithms to pharmaceutical demand forecasting and to assess their forecasting accuracy. The researchers compared machine-learning approaches in the context of pharmaceutical supply-chain demand and considered the potential contribution of advanced forecasting techniques to supply-chain recovery planning and resilience. The findings indicated that machine-learning approaches have potential for improving demand forecasting in pharmaceutical supply chains by identifying demand patterns and supporting more accurate predictions. The study concluded that improved demand forecasting can contribute to better supply-chain planning and resilience, particularly where demand is uncertain and traditional forecasting approaches have limitations. The researchers recommended greater exploration and application of machine-learning techniques in pharmaceutical forecasting, while recognising the importance of appropriate data and organisational capability. The study is relevant to the present research because it demonstrates the importance of forecasting accuracy in pharmaceutical supply chains; however, its emphasis was on the technical performance of machine-learning forecasting models rather than the relationship between forecasting accuracy and effective service delivery.

2.2.1 Synthesis of Empirical Review

The reviewed empirical studies generally demonstrate that demand forecasting is important for procurement planning, inventory management, supply-chain responsiveness, and operational performance. Merkuryeva et al. (2019) showed that forecasting methods can support pharmaceutical procurement decisions, while Zhu et al. (2021) demonstrated the potential of integrating supply-chain information and machine learning to improve forecasting. Ali et al. (2012) established that improvements in forecast accuracy can produce inventory benefits under certain conditions, while Theodorou et al. (2025) demonstrated that the operational value of forecast accuracy depends on inventory policies, costs, lead times, and demand characteristics. Petropoulos et al. (2018) similarly showed that forecasting methods should be assessed according to their practical inventory and service implications. Although these studies provide important evidence, most were conducted in pharmaceutical manufacturing, retail, or simulated supply-chain environments. There is therefore limited empirical evidence based on medical procurement and distribution organisations in developing countries, particularly Rwanda. The present study addresses this gap by empirically examining the effect of demand forecasting

accuracy on effective service delivery at BUFMAR in Kigali City, Rwanda.

3. Methodology

The study adopted a mixed-method research approach to examine the effect of demand forecasting accuracy on effective service delivery at BUFMAR in Kigali City, Rwanda. This approach enabled the researcher to collect and analyse quantitative information while also obtaining qualitative information to provide a deeper understanding of the forecasting practices and service-delivery processes. The study employed descriptive and explanatory research design. The descriptive design was used to describe the existing demand forecasting practices and the level of effective service delivery, while the explanatory design was used to determine whether demand forecasting accuracy had a significant effect on effective service delivery. The methodology was therefore aligned with the single specific objective of the study.

The target population consisted of 180 respondents drawn from BUFMAR staff and customers who were considered to have relevant knowledge and experience concerning procurement, inventory, demand forecasting, and service delivery. From this population, a sample of 124 respondents was selected for the study. The researcher used stratified sampling to ensure that relevant categories of respondents were adequately represented. The selection of respondents was based on their involvement in or experience with BUFMAR's supply-chain and service-delivery activities. The sample provided the basis for collecting information required to assess the relationship between demand forecasting accuracy and effective service delivery.

Data were collected using questionnaires, interviews, and documentary review. The questionnaire was the main instrument for collecting quantitative data and contained statements measuring demand forecasting accuracy and effective service delivery. Demand forecasting accuracy was assessed through aspects such as the use of historical sales information, adjustment of forecasts according to market and seasonal changes, analysis of forecasting errors, updating of forecasting tools, communication of forecasts, and the use of forecasts to guide procurement and production planning. Effective service delivery was assessed using indicators related to product availability, order fulfilment, timeliness, responsiveness, reliability, and efficiency. Interviews were used to obtain complementary qualitative information, while documentary review provided additional information from relevant BUFMAR records and reports.

The quality of the research instruments was ensured through validity and reliability procedures. Content validity was assessed to determine whether the

questionnaire items adequately represented the concepts under investigation. The study reported a Content Validity Index (CVI) of 0.900, indicating an acceptable level of content validity. Reliability was assessed using Cronbach's alpha, and the overall instrument produced an alpha coefficient of 0.903, demonstrating high internal consistency among the questionnaire items. These procedures helped to ensure that the instrument consistently measured demand forecasting accuracy and effective service delivery.

Quantitative data were coded, entered, and analysed using descriptive and inferential statistical techniques. Descriptive statistics, including frequencies, percentages, means, and standard deviations, were used to summarise respondents' views on demand forecasting accuracy and effective service delivery. Pearson correlation analysis was used to establish the direction and strength of the relationship between demand forecasting accuracy and effective service delivery. Regression analysis was used to determine whether demand forecasting accuracy had a statistically significant effect on effective service delivery. The null hypothesis was tested at the 5% level of significance, with a p-value below 0.05 considered statistically significant. Qualitative information obtained through interviews was analysed thematically and used to complement the quantitative findings.

Ethical considerations were observed throughout the research process. Respondents were informed about the purpose of the study and were requested to participate voluntarily. The researcher maintained confidentiality and anonymity by ensuring that information obtained from participants was used strictly for academic purposes. Respondents were also informed of their right to participate freely and to withdraw from the study where necessary. Permission to conduct the research was obtained from the relevant authorities, and the researcher ensured responsible handling, analysis, and presentation of the collected information. These procedures were intended to protect participants and maintain the credibility and integrity of the study.

4. Results and Discussion

This section presents and discusses the findings of the study in relation to its single specific objective, which was to assess the effect of demand forecasting accuracy on effective service delivery at BUFMAR in Kigali City, Rwanda. The results are presented using descriptive statistics, correlation analysis, and regression analysis, followed by a discussion of the findings in relation to previous empirical studies

4.1. Results

This study presents the findings of the study in relation to the specific objective of assessing the effect of demand forecasting accuracy on effective service delivery at

BUFMAR, Kigali City, Rwanda. The results are presented using descriptive statistics, Pearson correlation analysis, and regression analysis. The findings focus exclusively on the study variable of demand forecasting accuracy and its relationship with effective service delivery.

4.1 Response Rate

Table 1. Questionnaire Response Rate	Frequency	Percentage
Questionnaires distributed	124	100.0
Questionnaires returned	124	100.0

Source: Primary data, 2026.

All 124 questionnaires distributed to the selected respondents were returned, resulting in a 100% response rate. The complete return of questionnaires provided a full quantitative dataset for examining the relationship between demand forecasting accuracy and effective service delivery. The respondents included BUFMAR staff and customers with relevant knowledge or experience of inventory and service-delivery processes.

This section presents the descriptive findings on demand forecasting accuracy at BUFMAR. The study used a five-point Likert scale to measure respondents' perceptions of demand forecasting practices. The scale was coded as 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, and 5 = Strongly Agree. Mean scores and standard deviations were used to summarize the responses, where a higher mean indicates a higher level of agreement with the respective statement

4.2 Descriptive statistics on Demand Forecasting Accuracy at BUFMAR

Table 2. Demand Forecasting Accuracy

Statements	Mean	SD
Uses historical sales data to forecast product demand accurately	3.77	0.68
Adjusts forecasts based on seasonal trends and market fluctuations	3.42	0.93
Analyses forecasting errors to improve future predictions	3.84	0.59
Regularly updates forecasting tools to reflect current market conditions	2.2	0.71
Communicates forecasts clearly to relevant departments	3.57	0.85
Forecasting process helps prevent stock-outs and overstocking	3.69	0.76
Uses demand forecasts to guide procurement and production planning	3.9	0.45
Overall average	3.48	0.71

Source: Primary data, 2026.

The results in Table 2 indicate that demand forecasting accuracy was generally rated positively at BUFMAR, with an overall mean of 3.48 and a standard deviation of 0.71. This suggests that respondents generally agreed that demand forecasting practices were being applied in the organisation. The relatively moderate standard deviation also indicates that responses were reasonably concentrated around the mean, although some differences existed in respondents' perceptions of individual forecasting practices.

The highest-rated statement was that BUFMAR uses demand forecasts to guide procurement and production planning, which recorded a mean of 3.90 and a standard deviation of 0.45. This was followed by the statement that the organisation analyses forecasting errors to improve future predictions, with a mean of 3.84 and a standard deviation of 0.59. The findings suggest that BUFMAR places considerable emphasis on using forecast

information for planning and on learning from previous forecasting errors. The relatively low standard deviations for these two statements indicate a high level of consistency among respondents.

The findings further show that BUFMAR uses historical sales data to forecast product demand accurately, with a mean of 3.77 and a standard deviation of 0.68. Similarly, respondents agreed that the forecasting process helps prevent stock-outs and overstocking, recording a mean of 3.69 and a standard deviation of 0.76. Communication of forecasts to relevant departments also received a relatively high mean of 3.57 and a standard deviation of 0.85. These results indicate that historical demand information, forecasting communication, and the prevention of inventory imbalances are important components of the forecasting process at BUFMAR.

However, the lowest-rated statement concerned whether BUFMAR regularly updates forecasting tools to reflect current market conditions, which recorded a mean of only 2.20 and a standard deviation of 0.71. This indicates relatively low agreement and points to a potential weakness in the forecasting process. The statement concerning adjustment of forecasts based on seasonal trends and market fluctuations also recorded a comparatively lower mean of 3.42 and a standard deviation of 0.93. Overall, although demand forecasting accuracy was rated positively, the findings suggest that BUFMAR could improve its forecasting practices by regularly updating forecasting tools and incorporating current market and seasonal changes into demand predictions.

From the findings, the study revealed that demand forecasting accuracy at BUFMAR was generally practiced across the organisation. The findings indicated that BUFMAR uses historical sales information to estimate future product demand, adjusts forecasts in response to seasonal trends and market fluctuations, analyses forecasting errors to improve subsequent predictions,

communicates forecast information to relevant departments, and uses forecasts to guide procurement and production planning. The findings also showed that demand forecasting contributes to efforts to prevent stock-outs and overstocking. However, the study revealed a need for BUFMAR to strengthen the regular updating of forecasting tools so that they adequately reflect current market conditions. Overall, the findings demonstrate that demand forecasting is an important practice for supporting procurement planning, inventory availability, and service delivery at BUFMAR.

4.4. Correlation analysis

This section presents the Pearson correlation analysis conducted to determine the relationship between demand forecasting accuracy and effective service delivery at BUFMAR. The analysis establishes the direction and strength of the relationship between the two variables and provides an initial basis for assessing whether improvements in demand forecasting accuracy are associated with improvements in effective service delivery

Table 4: Relationship between Demand Forecasting Accuracy and Effective Service Delivery

	Demand Forecasting Accuracy	Effective Service Delivery
Demand Forecasting Accuracy	1.0	0.630
Effective Service Delivery	0.630	1.0

Note: The relationship was statistically significant at $p < .01$. Source: Primary data, 2026.

Pearson correlation analysis revealed a positive and statistically significant relationship between demand forecasting accuracy and effective service delivery ($r = 0.630$, $p < .01$). The coefficient indicates a moderately

strong positive association, meaning that higher levels of demand forecasting accuracy were associated with higher levels of effective service delivery at BUFMAR. The finding suggests that organisations that improve their ability to anticipate customer requirements are more likely to experience better availability, responsiveness, and reliability in service delivery.

Table 5 Regression Result for the Specific Objective

	B	Beta (β)	t	p
Demand forecasting accuracy	0.242	0.164	2.4	0.018

Source: Primary data, 2026.

The regression analysis reported a positive and statistically significant coefficient for demand forecasting accuracy ($B = 0.242$, $\beta = 0.164$, $t = 2.400$, $p = .018$). Since the p-value was below the 0.05 significance level, the null hypothesis that demand forecasting accuracy has no significant effect on effective service delivery was rejected. The result indicates that demand forecasting accuracy significantly contributes to effective service delivery at BUFMAR. The unstandardized coefficient suggests that a one-unit increase in demand forecasting accuracy was associated with a 0.242-unit increase in effective service delivery, holding the other variables included in the original regression model constant.

The finding is consistent with Adebayo and Okeke (2020), who found that accurate demand forecasting improves service delivery through better product availability and reduced supply disruptions. It also agrees with Mensah and Boateng (2021), who reported that effective forecasting mechanisms improve efficiency and responsiveness in healthcare supply chains. The result further supports the argument that forecasting should be treated as an operational decision-support function rather than merely an administrative planning activity.

The descriptive results provide additional explanation for the regression finding. BUFMAR performed strongly in using forecasts to guide procurement and production

planning, analysing forecasting errors, and using historical sales data. At the same time, the low rating for regularly updating forecasting tools indicates an area requiring improvement. Strengthening this aspect may improve the ability of BUFMAR to respond to changes in market conditions and customer requirements, thereby supporting more reliable service delivery.

4.6 Hypothesis Testing

Table 6. Hypothesis Decision

	Test Result	Decision
H01: Demand forecasting accuracy has no significant effect on effective service delivery	$B = .242; \beta = .164; t = 2.400; p = .018$	Reject H01

The null hypothesis was rejected because the p-value of .018 was less than the 0.05 significance level. The study therefore concludes that demand forecasting accuracy has a statistically significant positive effect on effective service delivery at BUFMAR, Kigali City, Rwanda. This conclusion is based directly on the regression coefficient reported in the thesis.

5. Conclusion and Recommendations

5.1 Conclusion

The study concludes that demand forecasting accuracy has a positive and statistically significant effect on effective service delivery at BUFMAR, Kigali City, Rwanda. The descriptive results showed that demand forecasting was generally implemented at a high level, while the correlation analysis demonstrated a positive association with service delivery. The regression coefficient was also positive and statistically significant, leading to rejection of the null hypothesis. The findings indicate that accurate forecasting helps BUFMAR anticipate customer requirements, guide procurement and production planning, reduce the likelihood of stock-outs and overstocking, and support reliable service delivery. The main weakness identified was the limited regular updating of forecasting tools to reflect current market conditions. This suggests that BUFMAR can strengthen the contribution of forecasting to service delivery by improving the timeliness, relevance, and integration of information used in forecasting. Greater use of current consumption information, market signals, seasonal trends, and forecasting-error analysis can support more responsive procurement and supply decisions.

The study tested the hypothesis concerning the effect of demand forecasting accuracy on effective service delivery at BUFMAR. The null hypothesis stated that there is no statistically significant effect of demand forecasting accuracy on effective service delivery at BUFMAR, Kigali City, Rwanda. The hypothesis was tested at a 5% level of significance, where a p-value less than 0.05 would lead to rejection of the null hypothesis, while a p-value greater than 0.05 would result in its retention.

5.2 Recommendation

Based on the findings of the study, the following recommendations are proposed to strengthen demand forecasting accuracy and improve effective service delivery at BUFMAR.

1. BUFMAR's Procurement and Supply Chain Department should establish a structured monthly forecasting review process that uses historical consumption, current customer demand, seasonal trends, market fluctuations, and previous forecasting errors. This will enable the organisation to identify changes in demand early and adjust procurement and replenishment decisions accordingly.
2. BUFMAR should strengthen collaboration among the Procurement and Supply Chain, Warehouse, Sales, and Management departments. Forecast information should be shared and discussed regularly to ensure that procurement, inventory, and distribution decisions are based on the same demand information. Clear responsibilities should also be assigned for preparing, reviewing, approving, and communicating forecasts.
3. BUFMAR should improve the use of forecasting software and provide regular training to staff responsible for demand forecasting and supply planning. The organisation should also monitor forecasting performance using indicators such as forecasting accuracy, stock-out frequency, emergency procurement, inventory availability, and order fulfilment performance. These indicators should be reviewed periodically to identify weaknesses and guide continuous improvement.

References

- Adebayo, T., & Okeke, C. (2020). Demand forecasting accuracy and effective service delivery in medical supply firms in Nigeria. *Journal of Healthcare Supply Chain Management*, 8(2), 55–72.
- Akande, S. A., & Enyejo, J. O. (2024). Leveraging predictive analytics to improve demand forecasting and inventory management in healthcare supply chains. *International Journal of Scientific Research in Science, Engineering and Technology*, 11(2), 624–644.
- Aldahmani, A., Alzubi, J., & Iyiola, O. (2024). Advanced analytics and demand forecasting accuracy in volatile environments. *Journal of Business Analytics*, 12(3), 45–62.
- Ali, A., Boylan, J. E., & Syntetos, A. A. (2012). Forecasting intermittent demand: A review of methods and applications. *International Journal of Forecasting*, 28(2), 402–413.
- BUFMAR. (2023). *Annual report and financial statements*. Bureau des Formations Médicales Agréées du Rwanda.
- Carpitella, S., & Izquierdo, J. (2025). Digitalization and automation in modern inventory management systems. *International Journal of Production Economics*, 278, 109012.
- George, S., & Elrashid, S. (2023). Inventory management and pharmaceutical supply chain performance of hospital pharmacies in Bahrain: A structural equation modeling approach. *SAGE Open*, 13(1), 1–13.
- Gunasekaran, A., Subramanian, N., & Papadopoulos, T. (2021). Information systems and inventory performance in healthcare supply chains. *Production Planning & Control*, 32(6), 483–496.
- Ivanov, D., & Dolgui, A. (2022). Viability of healthcare supply chains. *International Journal of Production Research*, 60(1), 1–20.
- Kagalwala, H., Radhakrishnan, G. V., Mohammed, I. A., Kothinti, R. R., & Kulkarni, N. (2025). Predictive analytics in supply chain management: The role of AI and machine learning in demand forecasting. *Advances in Consumer Research*, 2(1), 142–149.
- Khan, S. A., Yu, Z., & Golpîra, H. (2023). Digital transformation and inventory optimization in emerging healthcare markets. *Technological Forecasting and Social Change*, 186, 122143.
- Lee, H. L., Padmanabhan, V., & Whang, S. (1997). Information distortion in a supply chain: The bullwhip effect. *Management Science*, 43(4), 546–558.
- Mensah, E., & Boateng, K. (2021). Demand forecasting accuracy and healthcare service delivery in Ghana. *West African Journal of Health Logistics*, 7(2), 70–86.
- Merkuryeva, G., Valberga, A., & Smirnov, A. (2019). Demand forecasting in pharmaceutical supply chains using advanced analytical methods. *Procedia Computer Science*, 149, 540–547.
- Ministry of Health. (2022). *Annual health sector performance report 2021/2022*. Government of Rwanda.
- Mvuyekure, G., Ndagijimana, A., & Nsanzimana, S. (2024). Perceived benefits and barriers of electronic logistics management information system implementation in public health supply chains: A regional analysis. *Rwanda Journal of Medicine and Health Sciences*, 7(1), 35–48.
- Mutambudzi, M., Chikobvu, D., & Banda, M. (2022). Inventory management challenges in African healthcare supply chains. *African Journal of Economic and Management Studies*, 13(3), 445–460.
- Petropoulos, F., Wang, X., & Disney, S. M. (2018). The intermittent demand forecasting literature: A review. *International Journal of Forecasting*, 34(4), 894–912.
- Queiroz, M. M., Ivanov, D., Dolgui, A., & Fosso Wamba, S. (2022). Impacts of Industry 4.0 technologies on supply chain performance. *International Journal of Production Economics*, 247, 108432.
- Rahman, M., & Zainuddin, A. (2021). Demand forecasting accuracy and healthcare service delivery in Malaysia. *International Journal of Healthcare Operations*, 14(2), 99–115.
- Reiner, G., & Fichtinger, J. (2009). Demand forecasting and inventory management in supply chains. *International Journal of Production Economics*, 118(2), 435–445.

- Rwanda Biomedical Centre. (2022). *Annual health supply chain performance report*. Rwanda Biomedical Centre.
- Theodorou, E., Spiliotis, E., & Assimakopoulos, V. (2025). Demand forecasting and inventory management in healthcare supply chains. *International Journal of Forecasting*, 41(2), 455–470.
- Thompson, R. (2024). Demand forecasting accuracy and supply chain efficiency in medical supply systems. *Healthcare Management Review*, 15(1), 10–25.
- Wang, X., & Disney, S. M. (2016). The bullwhip effect: Progress, trends and directions. *European Journal of Operational Research*, 250(3), 691–701.
- World Health Organization. (2023). *Medical supply chains: Strengthening health systems through effective inventory and logistics management*. World Health Organization.
- Yani, L. P. E., & Aamer, A. (2022). Demand forecasting accuracy in the pharmaceutical supply chain: A machine learning approach. *International Journal of Pharmaceutical and Healthcare Marketing*, 17(1), 1–23.
- Yani, L. P. E., & Aamer, A. (2023). Supply chain collaborative planning, forecasting, and replenishment. *AIP Conference Proceedings*, 2646, 050044
- Zhu, Y., et al. (2021). Inventory management and demand forecasting in healthcare supply chains. *International Journal of Logistics Research and Applications*, 24(4), 345–362.