GRIFFITH COLLEGE DUBLIN

Assignment Cover Sheet

Learner name(s):	**SUSANNA KURIAN**			
Learner number(s):	[redacted]			
Assignment Type: **Course:**	**Individual: ✓** **MSc Digital Transformation**		**Stage/year:**	**Cohort 05 Sep 2024**
Module:	**Dissertation**			
Study Mode:	Full time	✓	Part-time	
Supervisor Name:	**Eucharia Esemuede**			
Assignment Title:	**The Impact of Cloud-Based Inventory Management Systems on Stock Optimisation and Real-Time Tracking Across Multiple Pharmacy Locations in UAE Chain Pharmacies**			
No. of pages:	**101**			
Uploaded to Moodle:	Yes			
Additional Info:				
Date due:	**24/08/2025**			
Date submitted:	**23/08/2025**			

Plagiarism disclaimer:

I understand that plagiarism is a serious offence and have read and understood the college policy on plagiarism. I also understand that I may receive a mark of zero if I have not identified and properly attributed sources which have been used, referred to, or have in any way influenced the preparation of this assignment, or if I have knowingly plagiarised my work or allowed others to plagiarise my work.

I hereby certify that this assignment is my own original work, based on my personal study and/or research, it is all written in my own words and I have acknowledged all references and sources used in its preparation. I also certify that the assignment has not previously been submitted for assessment and that I have not copied in part or whole or otherwise plagiarised the work of anyone else, including other students.

I have also not used any third parties, AI tools or websites to generate any parts of my assignment.

Signed & dated:  **23/08/2025**

The Impact of Cloud-Based Inventory Management Systems on Stock Optimisation and Real-Time Tracking Across Multiple Pharmacy Locations in UAE Chain Pharmacies

A dissertation submitted to Griffith College Dublin in partial fulfilment of the requirements for the Master of Science in Digital Transformation

Innopharma Faculty of Sciences

Griffith College Dublin

By

Susanna Kurian

September 2025

GRIFFITH COLLEGE DUBLIN

Candidate Declaration

I, Susanna Kurian hereby declare that this dissertation titled ***" The Impact of Cloud-Based Inventory Management Systems on Stock Optimisation and Real-Time Tracking Across Multiple Pharmacy Locations in UAE Chain Pharmacies"*** is my own original work and has not been submitted to any other institution for a qualification. I conducted this study under the supervision of Eucharia Esemuede, and I have properly credited all sources and references used in the study.

Candidate Name : Susanna Kurian

Candidate Signature : 

Date : 23/08/2025

Supervisor Name: Eucharia Esemuede

Supervisor Signature: 

Date: 23/08/2025

Acknowledgement

I am deeply grateful to my supervisor, Eucharia Esemuede, whose continuous guidance and thoughtful feedback helped refine the clarity and quality of this study. I would also like to express my sincere gratitude to my professional friends for their assistance in collecting survey responses, and to all participants for their valuable contributions to this study. Lastly, my family, friends, and colleagues deserve special thanks for their unfailing support and encouragement, which inspired me to complete this research.

Susanna Kurian

Table of Contents

List of Tables

.

List of Figures

List of Abbreviations

- ABC : Always Better Control
- ADC : Automated Dispensing Cabinets
- AI : Artificial Intelligence
- AWS : Amazon Web Services
- CAGR : Compound Annual Growth Rate
- CBIMS : Cloud-Based Inventory Management System
- CRM : Customer Relationship Management
- EMA : European Medicines Agency
- EOQ : Economic Order Quantity
- EPQ : Economic Production Quantity
- FDA : Food and Drug Administration
- IOA : Inventory Optimisation Analytics
- JIT : Just-In-Time
- PaaS : Platform as a Service
- RFID : Radio Frequency Identification
- ROI : Return on Investment
- UAE : United Arab Emirates
- VED : Vital, Essential, Desirable
- VMI : Vendor Managed Inventory

Abstract

The Impact of Cloud-Based Inventory Management Systems on Stock Optimisation and Real-Time Tracking Across Multiple Pharmacy Locations in UAE Chain Pharmacies

Susanna Kurian

Inventory is an organisation's core asset driving operational efficiency and profitability. This study explores the impact of cloud-based inventory management systems (CBIMS) on stock optimisation and real-time tracking across multiple pharmacy locations within pharmacy chains in the United Arab Emirates (UAE). The research aims to assess the outcomes of CBIMS in UAE pharmacies by examining previous inventory practices, features, benefits and challenges, potential to reduce stockouts and overstocking, and staff experiences of the system effectiveness in daily workflow.

A mixed-methods survey was conducted with 127 pharmacists and pharmacy managers, comprising closed-ended questions for statistical analysis and open-ended questions for thematic insights. The participants were selected based on their direct experience with CBIMS for a minimum of six months. The data were analysed using SPSS, Excel, and Tableau, with thematic coding applied to open-ended responses.

The findings revealed that CBIMS significantly enhanced real-time tracking, with participants reporting improved stock visibility, more efficient branch coordination, and streamlined routine tasks. However, the findings did not indicate a notable impact in stock optimisation, with statistical tests indicating no significant improvement in stock accuracy or decrease in overstocking. Furthermore, qualitative feedback from respondents emphasised key benefits such as reduced workload, efficient stock coordination, and minimised stock discrepancies, as well as challenges including reliance on stable internet connectivity, high installation costs, and the need for frequent training.

The study concludes that CBIMS are crucial for enhancing operational decision-making and real-time monitoring in UAE chain pharmacies, despite their limited ability to fully optimise stock levels. To optimise the potential of CBIMS, the study recommends improved integration with pharmacy operational systems, continuous staff training, and the incorporation of digital innovations.

This study provides valuable insights for stakeholders and policymakers driving digital transformation in pharmaceutical supply chains. It advances knowledge of sustainable inventory practices through CBIMS while enhancing operational efficiency and real-time monitoring.

Key Words : Cloud-based inventory management system, Stock optimisation, Real-time tracking.

CHAPTER 1

INTRODUCTION

1.1 Background to study

Pharmacy inventory management is a critical commercial and operational function that aims to control stock and minimise cost while ensuring the continuous availability of medical supplies (IBM, 2023). Pharmacies must guarantee an uninterrupted supply of essential items to prevent overstocking, expiry losses, and regulatory noncompliance. Decentralised inventory infrastructures and poor stock management contribute to avoidable shortages and inefficiencies in the global pharmacy landscape.

A 2021 report by the European Health Management Association (EHMA) found that lack of visibility of inventory and limited integration with other operational systems were the principal causes of medicine shortages in European pharmacies (Jongh et al., 2021). Eckford (2023) raises similar concerns. He argued that the absence of standard frameworks that provide updates on shortages, excess stocks, and expired products stored among pharmacies scattered over multiple locations creates inventory wastage as a significant challenge.

Conventional inventory management systems, specifically those based on manual procedures, spreadsheets, and local software, experience issues affecting operational efficiency and patient care. These challenges include overstocking, which raises holding costs and increases the risk of expiry, and stockouts, which affect patient safety and delay clinical services. Manual inventory management leads to incorrect demand forecasts and a lack of real-time visibility into stock levels, making it difficult to react quickly to demand variations or supply chain interruptions. Furthermore, these systems are susceptible to human error, such as misinterpretation by employees, leading to inventory inconsistencies. Additionally, the lack of integrated systems delays expiry management and complicates the detection and disposal of expired pharmaceuticals (Jaju et al., 2023).

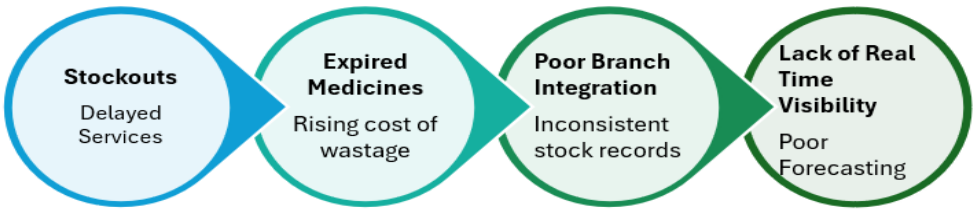

Figure 1: Key Operational Challenges in Traditional Pharmacy Inventory Management Systems (author's own)

Cloud-based inventory management is a digitised and automated method that eliminates the need for spreadsheets, local software installations, and conventional manual procedures. These systems work entirely on cloud infrastructure, eliminating the need for servers on-site and lowering the possibility of data errors by safely storing and facilitating online data access (Chloe, 2023). AI-powered cloud-based inventory management system (CBIMS) allows faster product updates, enhanced scalability, and efficient integration across multiple locations (Balar, 2024). The Business Research Company's January 2025 global market report highlights the need for real-time data, cloud-based inventory control and automated processes in the health care industry. The report also pointed out that growing number of pharmacies has contributed to the rapid adoption of pharmacy inventory management software solutions in recent years, and is expected to advance in the coming years (TBRC, 2025).

The retail pharmacy business in the United Arab Emirates (UAE) has undergone remarkable growth and transformation in recent years. The market was valued at USD 5.87 billion in 2023 and is estimated to reach USD 9.23 billion by 2029, with a compound annual growth rate (CAGR) of 7.8%. This growing trend is due to improved health awareness, a rising incidence of chronic illnesses, rapid urbanisation, population expansion, and continuing improvements in health care. Major retail pharmacy chains in the country continue to grow steadily, driven by innovative strategies, customer-centred services, and government support (MIR, 2024).

The UAE is progressing rapidly towards a more technologically advanced healthcare system driven by increased digitisation of retail and medical services. E-pharmacies, telemedicine, mobile health applications, and digital health platforms have transformed the pharmaceutical care provided to customers. Pharmacies are rapidly implementing integrated techniques to merge online and in-store experiences, improving accessibility,

convenience, and consumer engagement, while simplifying prescription processes and providing comprehensive health services (Focus, 2023; MIR, 2024).

As a pioneer in healthcare innovation and digital transformation in the region, the UAE highlights the significance of modern inventory solutions for the country's continuously growing chain pharmacy network. Although CBIMS have become increasingly popular in the healthcare industry, their application in retail chain pharmacies in the UAE are not well recognised. Considerable knowledge gaps exist on how these technologies affect routine tasks, optimise inventory levels, minimise waste, and affect real-time stock management within the specific context. These limitations led to the design of the current research, which seeks to investigate how CBIMS could enhance stock optimisation and operational efficiency in chain pharmacies in the UAE.

1.2 Aim of the Research

The purpose of this study is to examine the impact of cloud-based inventory management solutions on operational optimisation in retail chain pharmacies in the UAE, with a focus on their contribution to stock optimisation, real-time inventory control, and workflow efficiency.

1.3 Research Objectives

1. To examine how retail chain pharmacies managed their inventory before implementing cloud-based solutions.
2. To assess the key features of cloud-based inventory management systems that help with real-time tracking and stock optimisation.
3. To evaluate the benefits and challenges of implementing cloud-based inventory management in real-time tracking and stock optimisation across multiple pharmacy locations in the UAE.
4. To investigate the potential of cloud-based inventory management to reduce stockouts and overstocking in group pharmacies.
5. To assess the experience of pharmacy staff working in group pharmacies regarding the use, effectiveness, and impact of cloud-based inventory management in their daily workflow.

1.4 Research Questions

1. How did conventional inventory management techniques impact stock accuracy and operating efficiency in UAE retail chain pharmacies before the adoption of cloud-based solutions?
2. According to pharmacy staff, which specific features of cloud-based inventory management systems contribute to stock optimisation and real-time tracking?
3. What benefits and challenges do pharmacy chains experience when switching to a cloud-based inventory system?
4. How can multi-location pharmacies use cloud-based inventory management to reduce stock-related constraints like stockouts and overstocking?
5. What impact has the introduction of cloud-based inventory management systems had on pharmacy employees' daily duties and responsibilities?

1.5 Research Hypothesis

The study is based on the hypothesis that cloud-based inventory management solutions significantly improve stock optimisation and real-time visibility of pharmaceutical products at chain pharmacies in the UAE.

1.6 Justification and Significance of the Research

Retail pharmacies are a vital part of healthcare systems, responsible for the timely and effective delivery of pharmaceuticals to the public. The changing needs of current retail pharmacies fail to be addressed by traditional inventory systems that rely on manual processes or locally managed software. These systems eventually cause challenges like stockouts, overstocking, and supply chain disruptions. As pharmaceutical services in the UAE become more patient-oriented and digitalised, they require advanced technologies that facilitate rapid and accurate decision-making. Effective inventory management is therefore an operational responsibility as retail pharmacies increase and patient demands expand in the UAE (MIR, 2024).

International health authorities have emphasised the importance of efficient inventory systems. The European Medicines Agency reports that drug shortages remain a significant concern in all member states, often due to uncoordinated inventory management systems and poor supply chain visibility. The agency's 2023 annual report described the importance of using technologies such as cloud-based platforms to improve connectivity

between stakeholders and ensure supply chain visibility (EMA, 2024). Similarly, in its Tenth Annual Drug Shortages Report, the U.S. Food and Drug Administration (FDA) emphasised that communication delays and lack of centralised inventory data were the principal causes of shortages, particularly in retail settings. The FDA has suggested adopting cloud-based stock tracking technologies to enhance data accuracy, demand forecasting, and inventory management (FDA Drug Shortages, 2023).

In the context of rapid digitisation, the pharmacy industry is transitioning to technology-driven solutions that enhance patient safety, efficiency, and service quality. Analysing how digital technologies transform pharmacy stock management, enhance accuracy, and improve patient care highlights the significance of the current study. By delivering practical findings, this study supports the digital transformation of healthcare and offers ideas for improving the efficiency and quality of retail pharmacy services.

1.7 Overview of Dissertation

This dissertation is structured into five main sections, each addressing the study objectives related to the effect of CBIMS on stock optimisation and real-time monitoring in the UAE chain pharmacies.

First chapter introduces the study by providing background information, emphasising the importance of effective inventory control strategies. The chapter presents the study's objectives, research questions, and hypothesis, and provide significance for the research. It also presents the research framework.

The second chapter critically examines the existing literature on inventory management in pharmacy facilities. It begins with a theoretical and global review of inventory control methods, discusses current advances in cloud-based systems and their principal features. The review also looks at circumstances specific to the UAE, examining operational and technological factors influencing the adoption of cloud inventory technologies and identifies gaps in the literature. A conceptual framework is then developed on the basis of the literature review to align research design with study objectives.

Chapter Three describes the research methodology, including data collection and analysis strategy used to achieve the study objectives. It also discusses ethical issues, survey design, and sampling techniques used to conduct the research. The chapter further

describes how the data is collected, and the statistical methods used to evaluate the hypothesis and interpret the results.

Chapter Four presents and analyses data collected from pharmacy professionals working in retail chain pharmacies in the UAE. The results are analysed to evaluate the effects of CBIMS on the objectives of the current research. This chapter focuses on key trends, patterns, and insights on how effectively these systems operate to increase inventory accuracy, minimise stock issues, and improve overall operational performance.

The fifth chapter presents conclusions and recommendations from the study, offering a comprehensive overview of findings and how they align with the research objectives. The chapter provides practical suggestions for pharmacy stakeholders seeking to improve inventory processes using cloud-based systems and recommendations for further research to address emerging gaps. It also acknowledges the study's limitations and comprehensively summarises its contributions to academic understanding and real-world applicability.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Effective inventory management forms the backbone of pharmacy operations ensuring an optimal balance between resource use and inventory availability (Dubey et al., 2022). Major strengths of inventory management are efficient coordination and stock management, which reduce excess inventory, increase supply chain efficiency, and ensure that products are available whenever required (Hearson, 2024). Digital transformation became essential in today's rapidly shifting healthcare environment to improve service delivery and operational efficiency (WHO, 2021). Researchers and industry professionals are currently examining how cloud technology helps to achieve operational excellence, customer happiness, and inventory accuracy.

Cloud-enabled inventory solutions open up more opportunities for future pharmacy operations in the competitive pharmaceutical sector by facilitating better patient care, adherence to the law, and continued growth (Tony, 2023). The literature review examines the transition of retail pharmacy chains from traditional inventory practices to a modern cloud-based inventory management platform. By critically analysing previous studies, the study aims to comprehend how these digital solutions facilitate real-time tracking, increase stock optimisation, and enhance operational effectiveness.

This chapter commences with global perspectives and fundamental theories in inventory control, followed by conventional inventory procedures and their failures in maintaining accuracy and efficiency. Subsequently, the review provides an overview of cloud-based inventory management, emphasising the technical innovations that distinguish these systems from their traditional analogs. The following section examines the main characteristics of cloud-based inventory management systems, including scalability, automatic stock replenishment, and real-time tracking to promote organisational flexibility and operational effectiveness. The benefits and challenges of CBIMS are discussed further in the review. Additionally, the review focuses on stock optimisation using cloud-based inventory control, emphasising how advanced data analytics and artificial intelligence facilitate improved demand forecasting and stock replenishment. The evaluation also includes the experience of employees using cloud-based inventory management to assess how these technologies affect user acceptance, operational

flexibility, and overall job satisfaction. In addition, the analysis looks at the pattern of use of cloud-based inventory management techniques in the UAE pharmacy sector, followed by gaps in the current literature, highlighting areas that need further research to gain a deeper understanding of CBIMS. The chapter concludes by developing a conceptual framework based on the literature analysis to connect with the study objectives.

2.2 Global Perspectives and Fundamental Theories on Inventory Control

From theoretical and global perspectives, inventory management involves balancing product availability with customer needs while lowering costs associated with ordering, holding, and shortages. The ABC (Always Better Control) analysis, Economic Production Quantity (EPQ), and Economic Order Quantity (EOQ) are the basic concepts in inventory theory and practice. The EOQ model uses steady demand and fixed expenses to calculate the most appropriate order quantity to lower the overall cost of acquiring and keeping inventory. EPQ applies this logic to manufacturing environments where inventory is refilled progressively instead of a single time. ABC analysis, on the other hand, groups inventory according to turnover and value, enabling businesses to focus on essential product categories (Trường, 2021; Hayes, 2024).

Inventory theory further differentiates between stochastic models, which consider demand fluctuation and uncertainty, and deterministic models, which assume known and consistent demand. Stochastic models, such as the Newsvendor and (Q, r) models, are designed for situations where demand and lead times fluctuate and require probabilistic ways to reduce anticipated costs. On the other hand, deterministic models, like the basic EOQ, are more appropriate for stable conditions. Current inventory management utilises just-in-time (JIT) approaches that reduce the volume of inventory held and holding expenses by coordinating production and supply with real-time demand (Hayes, 2024).

Modern inventory platforms combine artificial intelligence (AI), machine learning, and Internet of Things (IoT) technologies to enable predictive analytics, automated restocking, and anomaly detection. These features reduce excess inventory, minimise stockouts, and facilitate data-driven decision-making. Additionally, features like barcode and RFID scanning, process triggers, and real-time dashboards diminish human error and ensure that inventory data is correct and dependable (Crudu, 2025).

2.3 Traditional Inventory Management

Traditional pharmacy inventory management systems relied heavily on manual procedures, decentralised systems, and experience-based decision-making, wherein managers used their judgment and prior experience to make decisions on stock replenishment. Conventional inventory methods used in the pharmacy include paper-based, Excel spreadsheets, and local software systems. Paper-based inventory management systems often led to inefficiencies like stock discrepancies and waste as they were more prone to human error, delays, inability to view stocks in real-time, and absence of standard control processes (Dharaniya et al., 2024). Although Excel-based systems offered a more structured method than paper, they were less reliable for large-scale or multi-location operations as they necessitate human data entry and formula updating and have limited error-checking or alerting features (Gaoual et al., 2025). Local software installed in individual pharmacies restricts its use for multi-location stock management in group pharmacies. These difficulties emphasise the need for scalable and integrated stock control solutions.

Jaju et al. (2023) have given an overview of inventory issues in a rural tertiary-care hospital in India, where pharmacy operations deal with traditional methods. These include manual inspection of inventory, regular audits, and basic ABC (Always Better Control) and VED (Vital, Essential, Desirable) analysis. Although these systems provide easy handling by categorising products in terms of cost and importance, they do not have the potential to support predictive or rapid inventory decisions in rapidly changing situations. In the same study, the fundamental issues observed with conventional systems were stockout, drug expiration, communication issues, and supplier inefficiencies that resulted from poorly integrated digital systems. Inventory management was reactive and thus resulted in overstocking or understocking.

Adirektawon et al. (2024) provide supporting evidence to emphasise the inefficiencies of traditional inventory methods. When they compared inventory processes of Thai hospitals, they discovered that conventional methods, indicating bulk purchase and group purchase, were the cause of excessive inventory holding costs, low turnover, and continuous mismatch between demand and supply. Additionally, such systems do not provide accurate forecasting, resulting in overstocking of low-demand items and severe shortages of high-use drugs. These inefficiencies increase further due to lengthy

procurement processes, administrative load, and a lack of information flow among stakeholders.

Therefore, conventional inventory control systems have become inadequate to meet the complex operational needs of retail chain pharmacies. The lack of real-time data, automation, and integration with digital systems results in stockouts and inefficiencies. These aspects signify the relevance of the current study as it assesses how CBIMS can improve inventory management, reduce shortages, and maximise pharmacy performance.

2.4 Optimising Efficiency Through Smart Inventory Control

Akter (2024) analysed key challenges in pharmacy inventory management and the benefits of optimising the pharmacy inventory using advanced technologies. The challenges identified by this study related to poor inventory management are overstocking, economic loss due to expiry issues, medicine shortage, and problems with the supply chain. In contrast cloud-based solutions offer multiple advantages, such as automated reordering, multi-location visibility, real-time tracking, and predictive analytics. These systems deliver precise, real-time information on stock levels and expiration dates utilising IoT, RFID, and AI technology. Authors' analysis showed that these systems adopt predictive models to analyse patient demographics, past sales data, and seasonal fluctuations to enhance demand forecasting. The study strongly connects improvements in the inventory system with optimised clinical outcomes; however, further research is necessary to understand the long-term financial implications and integration issues in different healthcare settings.

2.5 Cloud-Based Inventory Management Systems

The advent of CBIMS has significantly improved the accuracy and efficiency of inventory management across pharmacies and other healthcare providers. Cloud systems use internet-based programmes to store and update data instantly, enabling pharmacies to access, monitor, and manage stock at multiple locations from a central location. It also allows pharmacy employees to monitor product expiration dates, check live inventory levels, and manage the supply chain more effectively.

Ratnala et al. (2022) found that cloud computing simplifies order handling, inventory control, shipping, and regulatory compliance, which benefits business-to-business pharmaceutical applications. Their study highlighted ways cloud-based solutions enable

pharmaceutical businesses to optimise their supply chains through features like interoperability, adaptability, and AI-driven analytics. These findings provide compelling evidence to support the idea of cloud inventory systems introduced in current pharmacy operations.

Freeman Muhammad et al. (2024) provide further evidence about the impact of introducing modern analytics-enabled cloud-connected dispensing technology in 11 medical facilities in the United States. The report highlights a shift from tedious and ineffective human inventory adjustments to an automated inventory optimisation analytics (IOA) solution that allows real-time data incorporation across different digital systems. By providing continuous inventory updates, the cloud-based solution minimised stockouts and maximised the availability of medicines. From the study results, stockout rates declined to 100% of central pharmacies and 64% of automated dispensing cabinets (ADCs) upon incorporating advanced technologies into inventory management systems. Moreover, 82% of locations observed cost reductions, and 45% of facilities observed lower overall inventory levels. Although the study highlights the technological advantages, it fails to address real-world challenges. It is essential to apply these findings to the UAE setting considering the nation's diverse pharmacy network and varied levels of digital competence.

In contrast, Shashi (2023) offers a different perspective, even though cloud-based technologies can improve traceability, compliance, and responsiveness, which are necessary for ensuring patient safety and medication availability, systematic limitations require attention with the implementation of advanced digital technologies. Oracle NetSuite (2025) explains how cloud inventory solutions help organisations make better stock decisions by providing automatic replenishment, instant stock visibility, and expiration monitoring features. However, rather than addressing challenges specific to healthcare, the publication focuses more on broader business advantages.

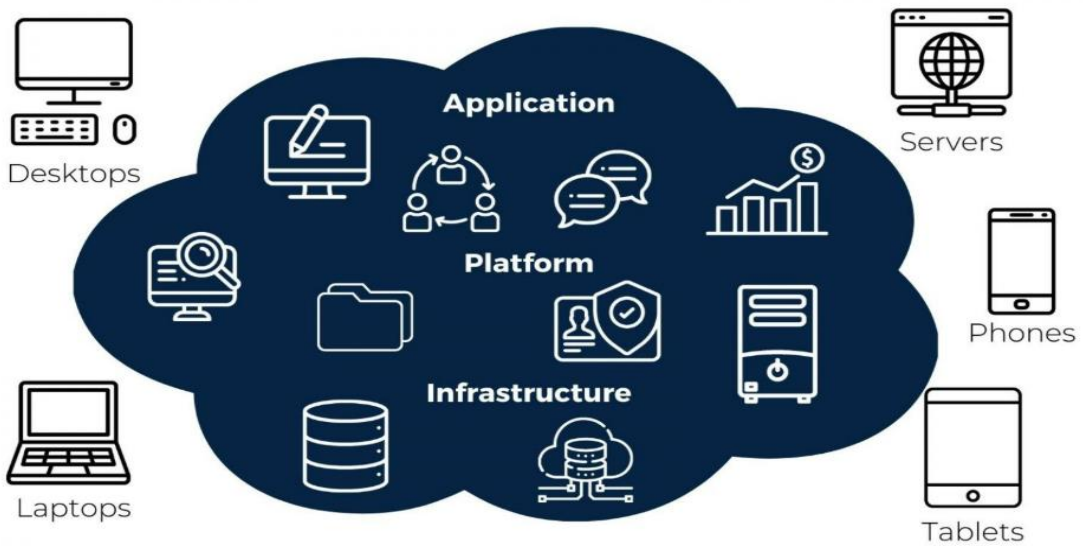

Figure 2: Cloud-based inventory management framework (Schueler, 2022).

2.6 Features of Cloud-Based Inventory Management

2.6.1 Real-Time Inventory Update

Addressing persistent issues such as stockouts, overstocking, and operational challenges in pharmacies requires optimising inventory management systems. As described by Akter (2024), an essential feature of CBIMS is its real-time tracking, which enables live inventory updates and generates alerts for different medicinal products supply reorders. Although Akter's research examines the practical advantages of these technologies, the study is limited to hospital pharmacy settings and fails to include empirical testing at chain pharmacies. This limits the study's applicability to community pharmacies distributed across various regions in the UAE.

A technical perspective by Jenkins (2025), who focuses on integrating Radio Frequency Identification (RFID) into cloud-based systems, argues that RFID minimises overstocking and waste by enabling immediate inventory updates and accurate product tracking, which is significant for managing various products in chain pharmacies. However, the study focuses on technological concerns, without considering practical aspects like cost, staff readiness, and infrastructural preparedness, which are crucial for successful adoption of cloud systems in healthcare settings like those in the UAE.

Ogbewele, Mbata, and Nwosu (2024) extend this viewpoint by recommending a globally applicable framework that combines RFID, IoT devices, and predictive analytics to

maximise pharmacy inventory control. Their concept aims for efficiency at scale through an integrated system that incorporates forecasting, purchasing, and inventory management. Despite having a strong theoretical foundation, the framework lacks case studies, or actual data, reducing its practical application. Moreover, it excludes localised challenges such as differing regulations or degrees of digital competence in every country.

Ashemore et al. (2023) present a contradictory viewpoint, indicating an imbalance between currently available technology and its practical application. The study findings showed that less than 35% of medications are digitally tracked in real-time, revealing that major healthcare systems constantly struggle with limited stock visibility, resulting in wasted opportunities for inter-branch transfers, delayed restocking, and expired goods. While the study contributes substantial knowledge to the literature, its special focus on hospital systems in North America makes it less relevant to the UAE's constantly transforming retail pharmacy industry, with varying capacities and constraints.

2.6.2 Automated Stock Replenishment and Demand Forecasting

Stock replenishment can be automated using pre-established reorder points within cloud-based technologies. A purchase order is automatically processed when inventory falls below the predetermined level to prevent stockouts and minimise the stock-related workload of employees (Jenkins, 2025). Ugbebor et al. (2024) discovered that automated inventory systems that used cloud computing and the Internet of Things increased stock accuracy by 35%, decreased stockouts by up to 45%, and reduced ordering durations by 60%. According to their research, sensor-based data collection and cloud platforms support regular product usage monitoring and enable the system to automate new orders upon meeting specific criteria. Additionally, their study demonstrates that forecasting algorithms integrated into these systems can analyse past sales and usage data to determine optimum reorder quantities, enabling better scheduling in the event of a public health crisis or seasonal demand variations. The study reveals that stable IoT infrastructure availability, efficient software integration, and appropriate user training are essential for the success of these systems. The study highlights a research gap in the user experience and operational effect of cloud-based automation in pharmacy-specific contexts, necessitating additional quantitative studies.

2.6.3 Tracking Product Expiry and Batch Details

Periodic monitoring of expiry dates and batch numbers of medications is vital for patient safety and legal compliance. Cloud-based systems enable traceability, recall management, and quality assurance through batch and expiry tracking. Empirical evidence supporting this feature is provided by Jadhao et al. (2024), in their study carried out in a hospital pharmacy setting, which showed that combining cloud inventory systems with RFID (Radio Frequency Identification) expiration tracking resulted in a 30% decrease in expired medication loss. The study highlighted that pharmacy employees can detect and eliminate risky inventory before expiration through automated warnings and real-time monitoring. The batch traceability feature enables rapid response during recalls and ensures rapid segregation without interfering with other pharmacy activities. While the study demonstrates practical advantages at the individual pharmacy level, it does not investigate how these systems perform across bigger multi-branch pharmacy networks.

2.6.4 Inventory Synchronisation Across Multiple Locations

Cloud enabled platforms are essential for managing stock across various locations in chain pharmacy settings. They eliminate the inefficiencies associated with traditional siloed systems, which can cause simultaneous shortages and overstocking at distinct branches. Through centralised dashboards and real-time visibility, these technologies help with the opportunity to effectively transfer inventory between branches, increasing stock availability and decreasing medication waste (Jenkins, 2025).

Using the Theory of Constraints as a framework, Shashi (2023) investigates this capability and argues that digital platforms can detect and eliminate barriers that restrict the movement of supplies between supply nodes. According to the study, integrated cloud systems promote less stockholding while enhancing communication across branches, which results in better supply continuity and more effective use of resources. These results are significant in retail settings with multiple outlets, where unconnected systems may cause shortages and overstocking in branches. Despite having a strong theoretical view, the study fails to examine its use in regular pharmacy operations. Key factors, including variations in infrastructure, staff involvement, and local regulatory requirements within the UAE are lacking in his study.

2.6.5 Remote Inventory Management Through Mobile Platforms

Oracle NetSuite (2024) suggests that cloud inventory platforms provide pharmacists and managers with options like remote approval of orders, monitoring inventory levels, and receiving real-time alerts from any internet-enabled device, such as tablets and smartphones. Group pharmacies benefit from mobile accessibility features to make timely and rapid decisions. Ale et al. (2025) further highlight the potential of IoT-enabled mobile devices offering inventory visibility. According to their analysis, mobile access to IoT data supports rapid decision-making and lowers supply chain interruptions. Although both sources describe the technical ability of mobile-based inventory management, information about pharmacy employees integrating these technologies into their daily tasks is lacking. Further studies are necessary to assess practical utility and adoption challenges related to remote inventory control through mobile platforms within actual pharmacy settings.

2.6.6 End-To-End Integration with Enterprise Systems

Based on Oracle NetSuite (2024), one of the most significant advantages of cloud-based inventory systems is their easy integration with other business systems, which allows organisations to combine inventory data with accounting, order processing, customer relationship management (CRM), and e-commerce for gaining an extensive operational overview. Azdan (2024) elaborates on simplifying regulatory filing and eliminating human errors through regular interaction between inventory, accounting, and compliance systems offered by NetSuite's pharma distribution solution. This integration is critical in multi-branch pharmacies, as decentralised systems are prone to inefficiencies, stock imbalances, and an increased operational burden. Both sources use a platform-centric approach and ignore the practical implementation issues, like previous software compatibility, integration barriers, and employee training requirements.

2.6.7 Operational Efficiency and Cost Reduction

Ujjawal (2023) found that cloud systems revolutionised business operations by lowering expenses and improving productivity. Together with automating ordering, pricing, storage, transportation, and purchasing procedures, these systems eliminate manual errors and human intervention. Automated updates and real-time inventory tracking increase accuracy, facilitating rapid completion of orders and optimum stock levels. Additionally, cloud solutions save revenue by eliminating the need for costly on-premises infrastructure

and lowering labour costs related to manual operations. Although the study provides the technical and financial benefits of cloud adoption, it bypasses implementation outcomes like initial setup costs, Return on Investment (ROI), staff adaptability, and operational problems in specific businesses like community or chain pharmacies.

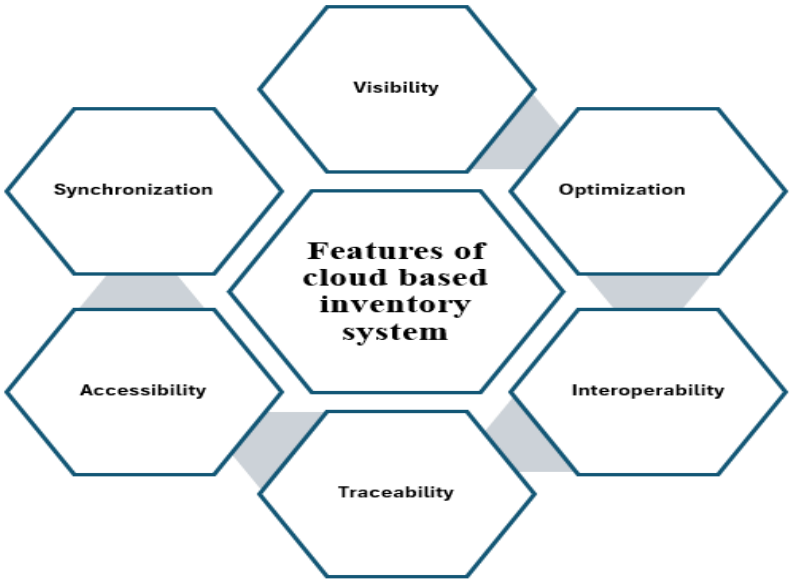

Figure 3: Features of a cloud-based inventory system (author's own)

2.7 Stock Optimisation Through AI and Automation

Leto (2025) found that integrating AI and automation into cloud-based inventory systems have significantly impacted pharmacy stock optimisation, particularly in multi-location pharmacies. These techniques assure compliance and efficient operation while resolving challenges like demand forecasting, waste reduction, and rapid decision-making. Efficient inventory control is essential for patient safety, adherence to the law, and financial success. Vangari (2025) advances this by stating that integration of AI and machine learning considerably enhances inventory control through accurate demand forecasting, real-time inventory visibility, and automated stock replenishment. By analysing past sales, market trends, and other variables, these technologies enable businesses to reduce overstock and stockouts, which results in reduced holding costs and improved customer satisfaction.

Choudhary (2024) further argues that AI-powered holistic decision-support models using algorithms like Decision Trees and Logistic Regression outperform conventional inventory techniques relative to accuracy and efficiency. Sajja et al. (2025) support this by demonstrating that machine learning, deep learning, and hybrid models notably

enhance forecasting accuracy to provide flexibility with seasonal and market fluctuations. With automated replenishment, optimised stock levels, low holding costs, and minimal stockouts, these models make inventory management resilient towards supply chain interruptions.

However, Thapa et al. (2025) add a more in-depth analysis by identifying automated processes within cloud-based inventory systems essential for improving operational effectiveness and stock optimisation. Incorporating real-time tracking into the cloud system using IoT allows organisations to monitor inventory levels and product movement across multiple locations more efficiently. This constant access ensures the accuracy of inventory data and a faster stock replenishment process. AI-powered automated restocking ensures accuracy, minimises human error, and maintains ideal stock levels to prevent shortages or overstocking by automatically starting stock replenishment when inventory levels drop below critical limits. Furthermore, anomaly detection algorithms detect anomalous inventory patterns, including sudden shortages or differences between system and physical stock, allowing for early remedial measures that minimise losses and disruptions to business operations. Even though these studies demonstrate the practical advantages of AI and automation in inventory optimisation, they concentrate on broad applications and fail to offer direct real-world evidence.

2.8 Benefits and Challenges in Implementing Cloud-Based Inventory Management

Existing literature frequently highlights the benefits of cloud-based inventory solutions optimised for stock accuracy and the prevention of stockouts. The primary benefit of the system is centralised information and real-time visibility, which allows businesses to make timely data-driven decisions and reduce errors common with manual or delayed inventory updates. Chebet and Mbandu (2024) conducted a study on Cloud-Enabled Machine Learning: A Framework for Revolutionizing Pharmacy Inventory Management in Nairobi County by integrating cloud-based inventory systems—specifically, AWS PaaS and XGBoost—into pharmacy operations, which offers several advantages such as predictive analytics, real-time tracking, scalability (60%), and improved operational efficiency (65%). These innovative techniques enhance multi-location inventory management, reduce overstocking and stockouts, and maximise forecasting accuracy, ensuring alignment with the goals of group pharmacies in the UAE.

Kartikasari (2024) explained that automated inventory systems through real-time monitoring and automatic stock updates additionally save staff time on manual inspections and facilitate faster product retrieval, allowing pharmacy staff to concentrate more on customer care. Findings also revealed the importance of examining historical trends that enable pharmacies to predict demand more accurately and prepare for seasonal changes like flu season, hence minimising the probability of stockouts or overstocking. Saha and Rathore (2024) extended this perspective further by designing an automated inventory management system using multi-agent reinforcement learning, demonstrating that automated replenishment and advanced data analysis speed up replenishment and enable the optimal balance between holding cost and operational performance.

Additionally, cloud-based solutions are known for their scalability and ability to manage operations across multiple locations. Centralising inventory data enables pharmacy chains to proactively distribute inventory, manage stock across multiple stores, and assure constant availability of items (Gupta et al., 2023).

Despite the benefits, research also identifies challenges to optimising the efficacy of cloud inventory solutions. Data privacy issues were the most common among challenges. Pharmacies become more vulnerable to cyberattacks, data breaches, and illegal access as they depend more on cloud services to store patient information and sensitive inventory, as evidenced by the study of Chebet and Mbandu (2024). They argue that even though AWS PaaS enhanced consumer views of privacy, constant vigilance and adherence to data protection laws are essential, especially in healthcare settings where patient privacy is the highest priority. They also added that internet connectivity is a crucial factor affecting the system's performance. Since cloud-based systems rely on a reliable network connection, any network failure could limit the availability of real-time data, which may delay critical inventory decisions and negatively affect patient care. These issues occur in areas with unreliable infrastructure, where pharmacies may need to spend money on backup connectivity options to reduce operating risk.

Interoperability with existing electronic health record (EHR) or pharmacy management systems creates a barrier to implementing cloud-based inventory systems. Both George and Elrashid (2023) and Saha and Rathore (2024) emphasise the organisational and technical challenges of combining new cloud-based systems with older software,

highlighting the significance of careful planning and resource allocation throughout the transition phase.

Change management and employee education are essential for the smooth operation of cloud inventory technologies. Chebet and Mbandu (2024) and Kartikasari (2024) reported that continuing staff education ensures employee skills for using machine learning algorithms and cloud-based technologies for inventory control and demand forecasting. Lack of staff training can lead to inadequate utilisation, errors, and reluctance to change, all of which may diminish the predicted benefits offered by the new system.

Lastly, the initial expenses of implementing cloud-powered inventory management into practice, including the software license, customisation, data transfer, and training, can be high, especially for big or multi-branch businesses, posing a serious challenge. However, a study by Chebet and Mbandu (2024) suggested that these initial expenditures are balanced with long-term increase in efficiency, accuracy, and cost reduction if the system is well integrated and maintained.

Cloud inventory systems offer valuable benefits in various healthcare contexts. The previous studies indicate that infrastructure availability, environmental variables, and technological skills are crucial for their performance. The lack of empirical data specifically analysing how these systems function in the unique context of UAE suggests the need for research that assesses the usefulness and implementation difficulties of cloud-based inventory management in the retail pharmacy sector in the UAE.

2.9 Employee Experiences with Cloud-Based Inventory Management in Group Pharmacies

A 2024 case study from Fudan University demonstrated that artificial intelligence and vendor-managed inventory (AI+VMI) system implemented in a hospital pharmacy network resulted in a 42.4% increase in supply chain efficiency and a significant decrease in inventory error rates from 0.425% to 0.025%. Pharmacy employees benefit from standard processes across various locations, improved access to real-time inventory data, and decreased administrative effort, which enables them to prioritize more on patient care and less on manual stock management. Additionally, the system enabled improved drug distribution, allocation, and settlement, which enhanced patient satisfaction and medication availability throughout the hospital network.

According to the researchers' findings, cloud-based platforms improve inventory control and regulatory compliance while enhancing the professional skills and level of service offered by pharmacy employees, positioning cloud technology as a fundamental component of future pharmacy practice (Shen et al., 2024). Even though the study delivers valuable insight into staff interactions in a centralised hospital setting, it bypasses the dynamics of cloud system use in distributed retail drug stores, highlighting the apparent need for additional investigation on consumer engagement and adaptation across diverse operational settings.

2.10 Cloud-Enabled Pharmacy Inventory Control in the UAE

Cloud technology plays a leading role in digital transformation of UAE healthcare systems. The national digital government plan of the UAE aims to promote innovation and enhance service delivery across various sectors, including healthcare (UAE Digital Government Strategy, 2025). Government-coordinated programmes like the National Unified Medical Record and Digital Government Strategy 2025 have helped speed up the introduction of cloud-based technology in the UAE healthcare industry. The policies focus on enabling data integration, interoperability, and centralised management of health services, including pharmaceutical services. Since retail chains of pharmacies in the UAE have multiple outlets in urban and semi-urban areas, cloud-based solutions provide required functionalities like automatic reordering, synchronised inventory tracking, and expiry date management (Belski, 2024).

Moreover, these competencies meet the requirements of UAE healthcare institutions as demonstrated by Ahmed et al. (2023) who studied the impact of big data in UAE healthcare facilities, offering insights for optimising pharmacy inventory management using cloud-based solutions. A quantitative analysis of three hundred healthcare professionals revealed that cloud solutions significantly improve inventory accuracy, accessibility, and visibility. Despite not being specific to retail pharmacies, the study emphasises the importance of cloud systems for processing and using inventory data across different sites.

In addition, the growing complexity of pharmaceutical supply chain and the rising expectations of patients for product availability and service quality are other factors driving cloud system use in UAE pharmacies. Real-time dashboards in cloud inventory system monitor inventory levels across different branches, enabling pharmacists to plan

inter-branch transfers, react quickly to stockouts, and balance procurement with actual demand.

Subsequently, the predictive potential of data quality in cloud infrastructures is highlighted by Ahmed et al. (2023), enabling proactive inventory processes instead of reactive methods. These are crucial for shaping the UAE urban pharmacy sector with high-quality service standards and quick customer turnover. Cloud and AI-powered analytical abilities are also making significant advancements in the region. According to Mobility Foresights' analysis, UAE pharmacies are implementing AI-enabled predictive technologies for demand forecasting, waste reduction, and operational efficiency. They observed that introducing sophisticated inventory management systems in pharmacies in Dubai resulted in an approximately ten percent decrease in medication waste, due to improved stock monitoring and control of expiry dates (Innovent, 2023).

Balar (2024) supports this trend even further, stating that cloud systems with AI-powered forecasting assist pharmacies in maintaining greater stock availability and lower rates of expired inventory. A qualitative examination of pharmacy employees utilising automated dispensing systems in UAE hospitals conducted by Hashad et al. (2021) found that perceived benefits and convenience of use resulted in workforce acceptance of cloud-based inventory solutions.

In contrast, despite the operational benefits of cloud-based systems, problems concerning cybersecurity and data protection prevent their widespread adoption in UAE retail pharmacies. The UAE's Federal Decree Law No. 45 of 2021 on Personal Data Protection is a comprehensive legal framework that regulates the collection, processing, and storage of personal data and must be complied by pharmacies managing sensitive medical and customer data. Therefore, in addition to operational demands, data protection and regulatory compliance must be considered while adopting digital transformation initiatives into the pharmacies (UAE Data protection laws, 2024; Dagher, 2025). Integration with national health platforms such as Riayati, initial expenditures of migration, and employee resistance to change—especially in small and medium-sized chain pharmacies are further challenges (Sisgain, 2025).

Recent market trends reveal the growing popularity of cloud-based and web-enabled applications because of their scalability, data-sharing potential, and regulatory compliance. Presenting cloud deployment as the leading category, the pharmacy

inventory management software market is valued at USD 2.6 billion in 2024 and expected to grow at a compound annual growth rate (CAGR) of 10.8% from 2025 to 2033 (Reports, 2024).

Finally, according to research and industry publications, cloud technologies have led to notable improvements in inventory visibility, expiration monitoring, and operational efficiency. Whereas issues regarding employee acceptance, data protection, and high implementation costs remain crucial factors. The limited studies on cloud inventory use in retail pharmacies highlight the significance of present study which provides evidence-based insights into how cloud-based applications have transformed inventory management in pharmacy chains in the UAE.

2.11 Identified Gaps in Literature

Existing literature indicates growing adoption of cloud-based inventory management systems in the pharmaceutical sector; however, significant gaps remain in understanding their application across retail chain pharmacy stores. Previous studies evaluated hospital-based contexts or general supply chain improvements. For example, Saha and Rathore (2024) and Freeman-Muhammad et al. (2024) investigated automated dispensing and digital stock control systems at institutional settings, and their findings are not transferable to retail operations, where stock variation, multi-location coordination, and service to customers are more essential. The use of inventory control and AI-driven optimisation in pharmacy settings has been discussed in a range of studies, for instance, those conducted by George and Elrashid (2023), Gupta et al. (2023), and Vangari (2025). They were theoretical and based outside the UAE region, with limited insights into the actual application of cloud inventory systems in the private pharmacy sector in the UAE.

Empirical data on the shift from traditional inventory systems to cloud-based platforms in UAE retail pharmacies is critically lacking. Even though research shows that smart inventory systems increase product availability, adoption barriers and issues like stockouts and overstocking in group pharmacies remain unaddressed. Despite the UAE's growing investment in healthcare innovation, limited studies evaluated how pharmacy professionals perceived cloud-based inventory systems in their daily operations. By addressing these gaps, the current study aims to provide actionable insights and suggestions for enhancing inventory management through understanding how inventory control systems operated before implementing the cloud technology, features, advantages,

and limitations of cloud-based inventory management, as well as its impact on the daily work of pharmacy employees.

2.12 Conceptual Framework

The conceptual framework summarises the main concepts and relationships synthesised from the literature review. The framework's central idea is cloud-based inventory management, which affect six major factors: pre-cloud inventory management, employee acceptance and adaptability, operational efficiency, advantages and disadvantages of cloud adoption, real-time tracking, and stock optimisation. Real-time tracking emphasises the benefits of instant stock level visibility, immediate alerts, and quicker decision-making. Operational efficiency results from time and cost reductions, minimal human mistakes, and enhanced workflows. Advantages and implementation barriers form the benefits and difficulties of cloud adoption dimension. Employee acceptance and adaptability emphasise the significance of staff experience, training, and ease of use for the effective implementation of cloud-based applications. Data-driven inventory planning, improved ordering accuracy, and decreased overstocking and stockouts facilitate stock optimisation. The framework concludes by contrasting these advancements with the limitations of traditional inventory control, such as overstocking, delayed decision-making, and inadequate stock visibility.

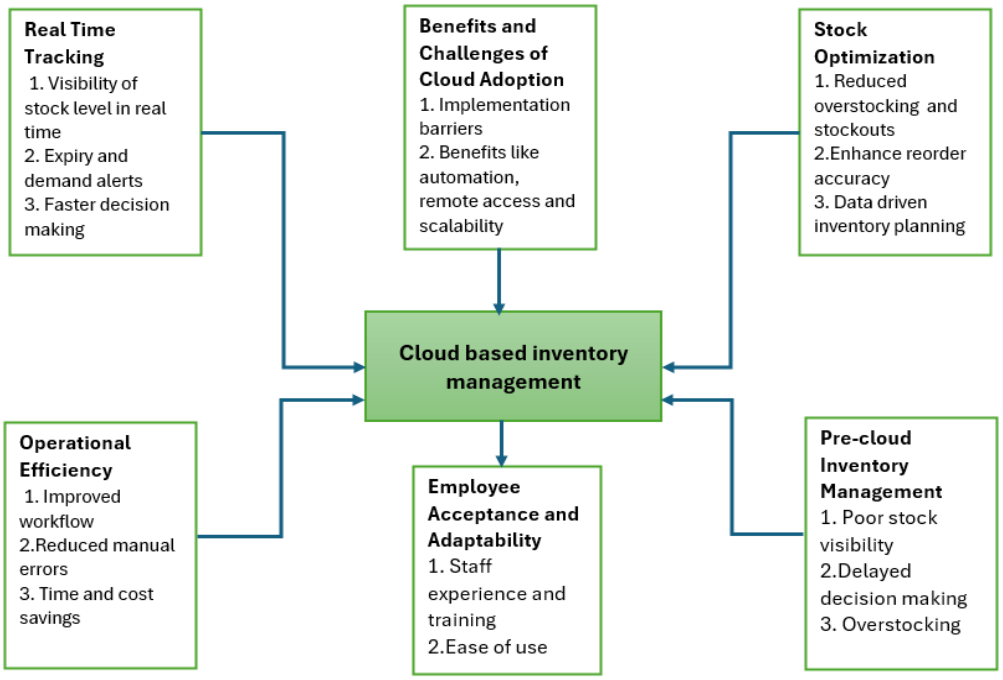

Figure 4: Conceptual framework developed for the study (author's own)

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Introduction

The structured approach used to investigate the impact of Cloud Based Inventory Management Systems (CBIMS) on the operational efficiency of chain pharmacies in the United Arab Emirates (UAE) forms the study's research methodology. Based on the theoretical knowledge gained from the literature review, this chapter describes the study design, the collection and analysis of data, and practical and ethical considerations at all phases of the research. The study adopted a mixed-methods approach to integrate both qualitative and quantitative insights. A survey with structured questions aids in gathering quantitative data, allowing analysis of the system's efficacy in areas like workflow efficiency, real-time tracking, and stock management. Open-ended survey questions, on the other hand, provide qualitative insights by drawing detailed participant experiences, opinions, and suggestions. The Research Onion framework, presented by Saunders et al. (2019), is used to structure the research methodology, which offers a multi-layered approach to describe the study's philosophical basis, research design, data collection procedures, and analytical methods.

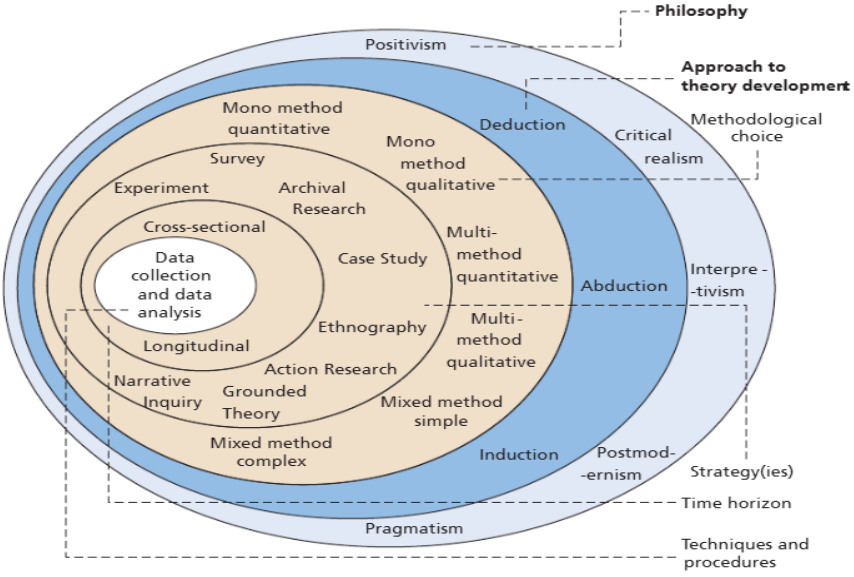

Figure 5 :Research onion model developed by Saunders (Saunders et al., 2019)

3.2 Summary of Research Methodology

A structured overview of the research methodology using Saunders' Research Onion layers, is presented in Table 1.

Table 1: Research methodology summary applying Saunders' Research Onion

Methodology Level	Chosen Method
Research Philosophy	Pragmatism
Research Approach	Deductive Approach
Methodological Choice	Mixed Method (Qualitative + Quantitative)
Research Strategy	Survey (Online Questionnaire)
Time Horizon	Cross-Sectional
Techniques and Procedures	SPSS, Tableau, and Thematic Analysis

3.3 Philosophical Approach

The outermost layer of the research onion that directs methodological choices is the philosophical foundation of the study, which defines the researcher's perspective on the nature of reality (ontology), the nature of knowledge (epistemology), and the values guiding the research (axiology) (Saunders et al., 2019). The research philosophy chosen for the study is pragmatism, which focuses on the practical and solution-oriented goals of the research objectives. Pragmatism is appropriate for studies that examine complex practical issues, such as the introduction and effects of CBIMS in chain pharmacies in the UAE, where multiple perspectives and approaches contribute to meaningful conclusions. Rather than limiting to a single paradigm, a pragmatic philosophical approach emphasises research problems and applies all methods to comprehend them. Since the goal of this study is to examine both the measurable advantages (like real-time tracking and stock optimisation) and the personal views of pharmacy employees, pragmatism makes it easier to combine quantitative (such as surveys) and qualitative (such as open-ended feedback) methods of gathering data.

Pragmatism concurrently promotes methodological adaptability and strongly emphasises the practical relevance of results in particular situations. According to Kaushik and Walsh (2019), pragmatism enables researchers to integrate methods that effectively answer the research questions and deliver actionable results. This philosophical approach allows the study to offer a comprehensive data examination by assessing the operational and

employee-related outcomes of implementing centralised inventory systems across pharmacy branches in the UAE.

3.4 Research Approach

Research approach help to establish a relationship between theory and facts in a study. This involves applying a deductive approach to test preexisting ideas, an inductive method to build new theories based on observations, or an abductive approach to combine both to discover valuable observations (Saunders et al., 2019). The current study uses a deductive approach, beginning with assumptions obtained from recent studies and verifying them with real-world information. The study examines how CBIMS affect stock optimisation, real-time tracking, and inventory accuracy in chain pharmacies in the UAE. A structured questionnaire with closed-ended questions were used to collect primary data, allowing the application of statistical techniques to evaluate the hypothesised relationships and assess their significance.

The survey contained open-ended questions to acquire detailed information about study goals. Instead of creating new theoretical frameworks, these qualitative responses enhance and strengthen the quantitative insights. This supports the study's deductive integrity, with qualitative answers providing descriptive explanations.

3.5 Research Strategy

The research strategy defines the approach followed to meet the goals for collection, analysis, and interpretation of data to effectively respond to the research questions (Saunders et al., 2019). This research followed a survey method, which is effective for evaluating hypotheses over a wide range of people, to investigate the practical effects of CBIMS. The strategy was based on a deductive approach, in which the literature findings were evaluated against empirical research using information gathered from pharmacists and pharmacy managers employed at retail chain pharmacies in the UAE. This approach facilitates the investigation of connections between factors, including stock optimisation, real-time monitoring, and system usage, employing a systematic framework.

In healthcare and pharmaceutical research, survey methods are appropriate for analysing systemic outcomes, operational behaviours, and professional perspectives. The survey used in the study consisted of closed-ended questions for statistical analysis, with three open-ended questions added to obtain basic contextual information.

3.6 Research Methodology

The basis of any study was rooted in a suitable research methodology, which ensures that the research questions were examined using appropriate techniques (Saunders et al., 2019). A mixed-methods research methodology is employed in this study to integrate quantitative and qualitative features to comprehend the effects of CBIMS in chain pharmacies in the UAE. A structured online survey aimed at pharmacy managers and licensed pharmacists employed by retail chains was the tool for data gathering. Open-ended questions in the survey focus on individual perspectives and contextual knowledge, whereas closed-ended (Likert-scale and multiple-choice) questions measure staff responses regarding the stock optimisation, real-time tracking, and system use. Mixed-methods methodology offers a balanced strategy to facilitate a comprehensive understanding of the advantages and difficulties of cloud-based solutions.

3.7 Time Horizon

The Saunders' Research Onion's time horizon layer enables researchers to identify whether their study is cross-sectional or longitudinal by providing the duration of data collection. This research used a cross-sectional time horizon, which implied that participant responses were collected once. The design is appropriate, where the study intends to establish the current status of a phenomenon as compared to studying the same over a specific duration. The cross-sectional design is suitable for evaluating operational efficacy and the impact of centralised inventory systems independent of time variations. Additionally, the cross-sectional approach facilitates the pragmatic aspect of the study by offering rapid insights into the current stage of implementation, interaction of users, and perceived benefits of cloud inventory technologies without requiring the extended time and resources of a longitudinal study. Geographical limitations were eliminated through online surveys, allowing for effective and comprehensive data collection across various locations.

3.8 Data Collection and Analysis

Data gathered from pharmacists and pharmacy managers working at retail chain pharmacies in the UAE using an online questionnaire. The questionnaire was shared with target participants via Google Forms, which enabled anonymised participation and facilitated efficient data collection across diverse locations. The survey consisted of twenty-two questions, including comments on a Likert scale, closed-ended multiple-

choice questions, and three open-ended ones to gather additional responses. The questions addressed the study objectives like pre-cloud stock management practices, key features of currently available cloud-based systems, real-time tracking capabilities, stock optimisation, staff experiences, and perceived benefits and limitations of the system.

3.8.1 Target Participants

Licensed pharmacists and pharmacy managers working in retail chain pharmacies in the UAE were the targeted participants for the study, as they were primarily the end-users of cloud-based stock management solutions in their organisations and have direct experience with inventory management processes. The opinion and feedback of pharmacists and pharmacy managers were critical for this research since their response provides direct and practical data on the real use, benefits, and problems of CBIMS in the retail pharmacy setting, and their perspectives will enhance the significance of the research findings.

3.8.2 Participant Selection Criteria

Participants were selected based on predefined inclusion criteria to ensure the validity and relevance of the data collected. The following standards were considered in selecting participants for the study.

- Registered pharmacist or pharmacy manager currently working at a retail group pharmacy.
- Experience with a cloud-based inventory management solution for at least six months.
- Fluent in the English language to understand and respond appropriately to the survey.

Individuals without CBIMS experience and those who failed to provide consent were excluded from the study.

3.8.3 Sample Size Calculation

According to current market statistics, the UAE has between 2,500 and 3,000 retail pharmacy stores, with chain pharmacies accounting for the majority (Insights10, 2022; Credence Research, 2025). Using a midpoint (2,750 outlets) and assuming 75% are chain pharmacies with 2.5 pharmacists per branch to manage shifts and lengthy operating hours, the estimated number of retail chain pharmacists in the UAE is 5158. Using Cochran's method for sample size calculation, a sample size of 358 retail chain pharmacists would

be appropriate to attain a 95% confidence level with a 5% margin of error for this population (Ahmed, 2024).

Cochran's Formula

$$n_0 = \frac{Z^2 \text{ x } P\ (1\text{-}P)}{e^2}$$

Where, n_0 = Sample Size, Z = Z Score (1.96 for 95% confidence interval), P = Population Proportion (5%) and e = Margin of Error (5%).

The sample size is 384 for a large population.

Applying Finite Population Correction (for N = 5158)

$n = n_0 / [1 + (n_0 - 1) / N]$

Hence, the study intends to collect 358 complete responses.

3.8.4 Sampling Technique

The research employed a non-probability sampling approach that combines snowball and purposive sampling techniques. Pharmacists and pharmacy managers who worked at retail chain pharmacies in the UAE were contacted initially based on the professional network of the researcher to meet the inclusion criteria. To maximise survey coverage, participants were requested to share the questionnaire with colleagues in related roles, creating a snowball effect. The practical constraints of accessing a probabilistic sample frame and the lack of a publicly accessible database of retail pharmacists in the UAE led to the choice of this approach.

3.8.5 Ethical Considerations

Even though survey methods are associated with minimal risk, ethical concerns and issues must be addressed to comply with academic research standards.

Following ethical approval, the online survey was distributed to target participants to ensure that the research complies with all institutional and legal standards regarding the use of human subjects. The survey began with participant information that consisted of the title, purpose of the study, voluntary features, the estimated completion time, and

assurance of the security of responses and anonymity. Participants were requested to offer consent through a mandatory digital checkbox under the GDPR compliance regulation and at the institutional level.

In compliance with ethical guidelines, all responses were safely stored in password-protected files accessible only by the researcher. To avoid data loss and ensure data integrity throughout the study, a backup copy of the data was stored safely on a cloud storage platform. Efforts to maximise inclusivity and diversity were offered by disseminating the online form in a range of professional pharmacy networks, geographical areas of the UAE, and social media to attain multiple views without bias. For transparency and support, the contact details of the study author have been provided in the questionnaire. Additionally, precautions were taken to ensure that participants were not exposed to any risk arising from their participation.

3.8.6 Data Analysis

The study examined the impact of CBIMS in chain pharmacies distributed across the UAE using a mixed-methods approach to data analysis through qualitative and quantitative methods. The dual methodology offers a balanced view of how cloud-based inventory systems can influence the optimisation of stocks and real-time visibility in chain pharmacies in the UAE. Statistical Package of Social Sciences (SPSS) and Microsoft Excel were used for closed-ended survey response analysis, and open-ended qualitative data were analysed using thematic analysis.

3.8.6.1 Quantitative Data Analysis

Microsoft Excel and SPSS were used to analyse the quantitative data gathered from closed-ended survey questions. The main goals of this stage are to summarise the overall trends and quantify variables like system use, inventory accuracy, stockout reductions, and workforce satisfaction.

Initially, the completeness and consistency of the quantitative data gathered are verified to ensure the quality of responses. Then the cleaned dataset was moved to SPSS to illustrate participant demographics and answers to key questions using descriptive statistics like means, frequencies, percentages, and standard deviations. Descriptive statistical results reveal a comprehensive overview of the sample characteristics and trends in system utilisation, observed benefits, and functional challenges.

Inferential statistical tests were applied to examine the relations and variability among specific factors such as user roles and the reported improvements in stock accuracy. A chi-square test enabled the evaluation of association between categorical data. Participants' mean ratings on stock optimisation and real-time tracking were compared to a neutral baseline score using a one-sample t-test, which determined whether perceptions deviated significantly from the expected average. Statistical significance was measured by setting the significance threshold at $p < 0.05$.

3.8.6.2 Testing of Hypothesis

The primary hypothesis underpinning the study was: Cloud-based inventory management solutions at chain pharmacies in the UAE significantly improve stock optimisation and real-time visibility of pharmaceutical products. The mean scores of participant responses related to crucial operational indicators like stock accuracy, stockout frequency, automated stock monitoring, real-time tracking satisfaction and alert efficiency were compared using one-sample t-test to analyse the hypothesis. The test was appropriate since it assesses the differences between two related features reported by the same subjects. Chapter 4 discusses and interprets the findings of these tests, which were conducted with a significance level of $p < 0.05$ to assess whether the observed changes were statistically significant.

3.8.6.3 Data Visualisation

Tableau and excel facilitated the creation of visual summaries of the results to interpret and clarify the numerical data. Bar charts and pie charts developed using the application demonstrate trends in user feedback, satisfaction levels, and operational enhancements with CBIMS in use. These visual illustrations enable easy understanding of the results and promote greater interaction with patterns that may not be easily identifiable in numerical data.

3.8.6.4 Qualitative Data Analysis

The survey gathered open-ended responses for an extensive analysis of the user experiences regarding CBIMS. Thematic analysis was applied to examine qualitative responses, adhering to the six steps described in "A worked example of Braun and Clarke’s approach to reflexive thematic analysis" by Byrne (2022). Gaining familiarity with the data, creating the initial codes, identifying themes, analysing themes, defining,

and classifying themes, and developing the final report are the steps used in the thematic representation of qualitative insights. These qualitative findings complement the quantitative results by providing real-world examples and practical context regarding various aspects of CBIMS (Byrne, 2022).

3.8.7 Validity of the Responses Collected

The questionnaire was developed according to the research objectives to ensure the authenticity and reliability of the data collected. Stock optimisation, real-time inventory visibility, advantages, difficulties, and employee experiences with CBIMS in retail chain pharmacies were the themes directing the survey questions. The online survey was limited to pharmacy managers and pharmacists who have experience with cloud inventory systems to confirm that all data acquired was appropriate. Additionally, clear, and consistent sentence structure, with appropriate feasible options for responses, ensured the reliability of collected responses.

3.9 Conclusion

The methodology used in this research provided insightful information into the efficiency of CBIMS in UAE chain pharmacies. The combination of statistical analysis and thematic interpretation enabled an accurate evaluation of both professional experiences and quantifiable results. Adherence to the study's ethical requirements strengthened the validity of the data and its applicability to current pharmacy practice.

CHAPTER 4

FINDINGS AND ANALYSIS

4.1 Introduction

The significance of cloud-based inventory management systems (CBIMS) on stock management and operational efficiency across chain pharmacies in the United Arab Emirates (UAE) was assessed through analysis of the data gathered in this study. The analysis aimed to identify patterns, trends, and correlations between the usage of CBIMS and outcomes such as decreased stockouts, enhanced stock accuracy, streamlined workflow, and immediate access to stock data. These relationships were measured using descriptive and inferential statistical techniques, while technical challenges and real-world experiences were captured by examining open-ended responses. The online survey was answered by 127 pharmacists and pharmacy managers, all of whom had no less than six months of first-hand experience with CBIMS. Their collective views represented a variety of pharmacy sizes and operational settings, which enabled the results to offer an in-depth understanding of CBIMS implementation, the observed advantages and the challenges experienced in the UAE retail pharmacy market.

4.2 Background Information of Participants

4.2.1 What is your current position?

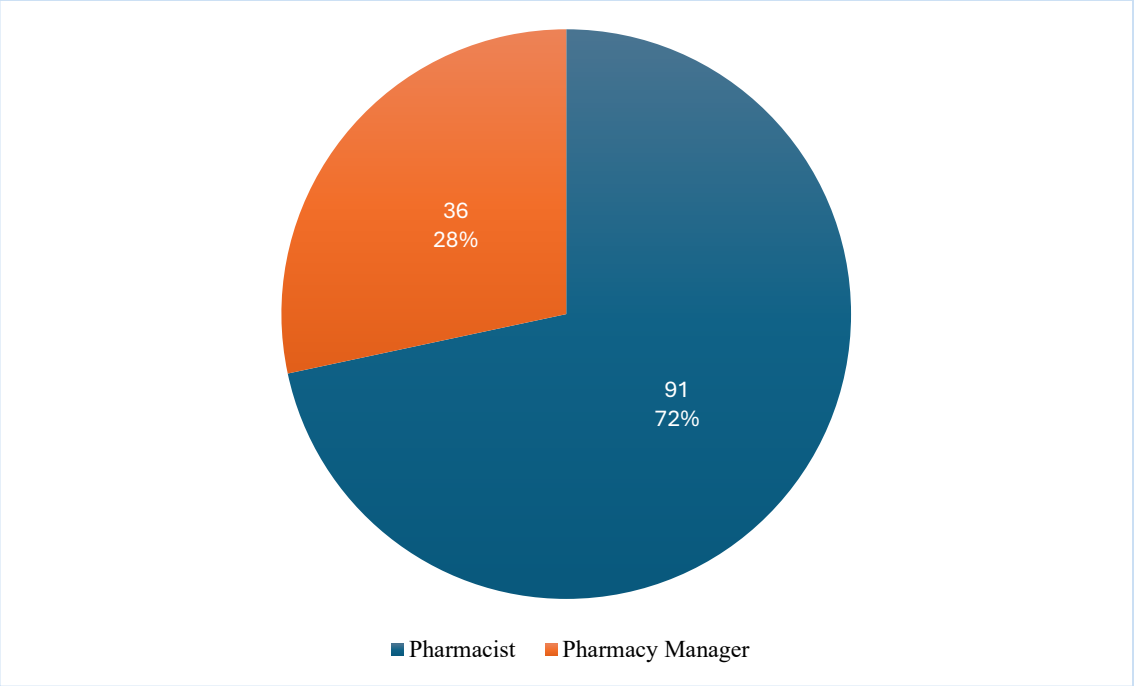

Figure 6: Participant Distribution By Current Position (%)

The online survey included a total of 36 (28%) pharmacy managers and 91(72%) pharmacists. The questionnaire was completed by 127 participants in total. The distribution, as shown in figure 6, indicates that majority of the study's responses were from pharmacists who actively participated in daily patient services, inventory control, and dispensing. Pharmacy managers were included to ensure that strategic and managerial perspectives were addressed, thereby providing an accurate examination of the administrative and operational dimensions of CBIMS in the UAE.

4.2.2 How long have you been employed at retail pharmacy?

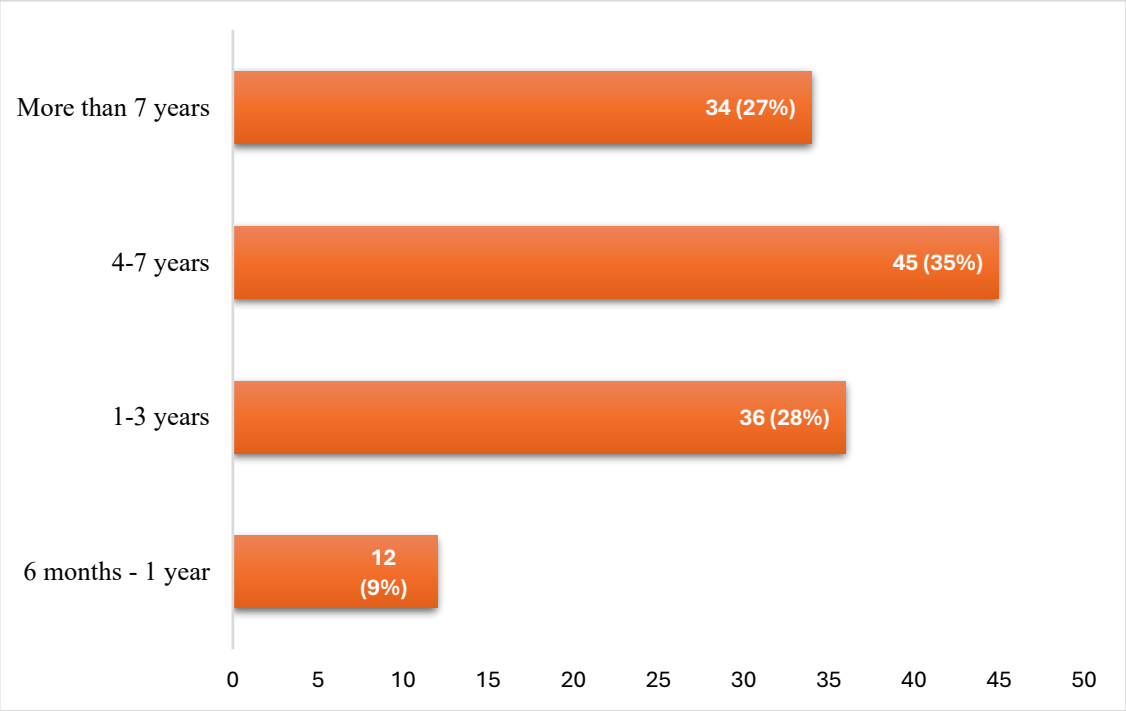

Figure 7: Participant's Employment Duration in Retail Pharmacies

Figure 7 shows the distribution of respondents' based on their work experience in retail pharmacies. Of the 127 responses, 45 respondents (35%) reported having four to seven years of experience, whereas 36 (28%) had one to three years of experience. Additionally, the smallest group of respondents, 12 (9%), had been working for 6 months to 1 year, whereas 34 (27%) had more than 7 years of experience. This pattern of distribution suggests that most participants possess several years of work experience, providing informative ideas on inventory management practices.

4.2.3 How many pharmacies does your company operate in the UAE?

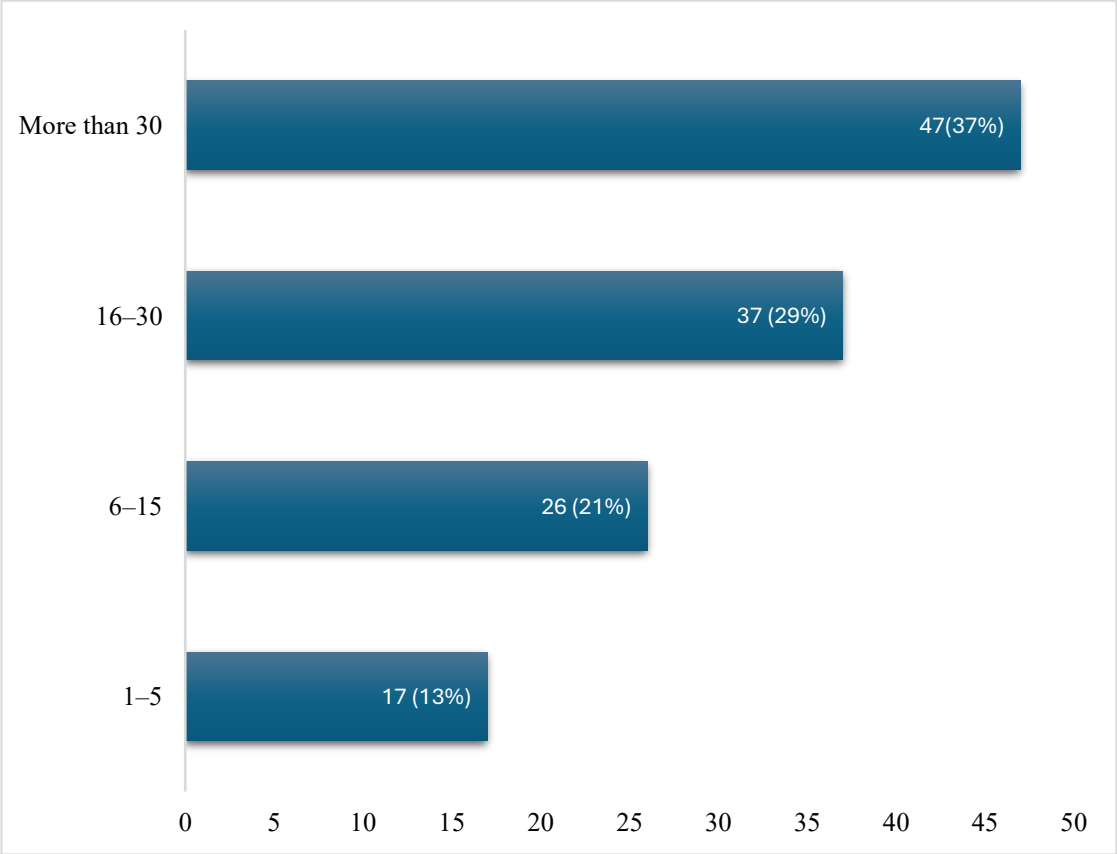

Figure 8: Participant Distribution by Pharmacy Network Size in the UAE

According to the analysis of 127 responses presented in figure 8, the majority of participants 47 (37%), worked for companies that operated more than 30 pharmacies throughout the UAE. This was followed by 37 respondents (29%) from groups operating across 16 to 30 pharmacies. While another 26 participants (21%) worked for companies with 6 to 15 pharmacies. The lowest proportion with 17 participants (13%), served for organisations with 1 to 5 pharmacies. The observed trend revealed that the majority of the study's findings were obtained from larger retail pharmacy chains with multiple branch networks.

4.3 Objective 1 analysis: To examine how retail chain pharmacies managed their inventory before implementing cloud-based solutions

4.3.1 What type of inventory management system did your pharmacy utilise before switching to a cloud-based solution?

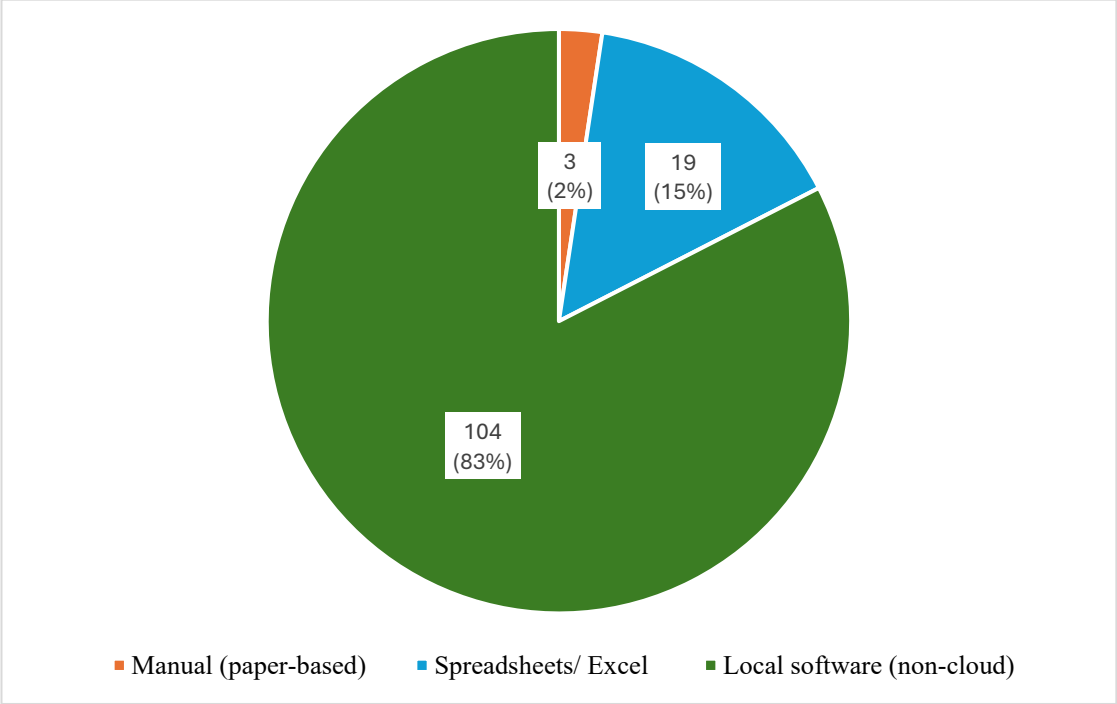

Figure 9: Inventory Management Systems Used Before Cloud Adoption

As shown in figure 9, participants were asked about type of inventory management used before the introduction of cloud systems. A total of 126 participants shared their feedback. The findings indicate that a large proportion of sample group 104 (83%) had previously used local software to manage inventory. This indicated that the majority of retail pharmacy businesses had previously adopted some sort of digital infrastructure prior to the introduction of cloud-based solutions, which may have lowered the technological challenges associated with migration. A lesser but significant portion, 19 (15%) stated that their previous inventory tool was Excel or spreadsheets. Although this method is digital, it often lacks automated features, real-time updates, and connectivity capabilities provided by expert systems.

Only three participants (2% of the total) relied entirely on manual, paper-based methods, which is a more conventional technique less common in current pharmacy operations. The overall pattern demonstrated that adoption of cloud computing in these

pharmacies suggested an upgrade from partially digital methods to fully integrated, centralised inventory management platforms.

4.3.2 Please rate the following features of your previous inventory system:

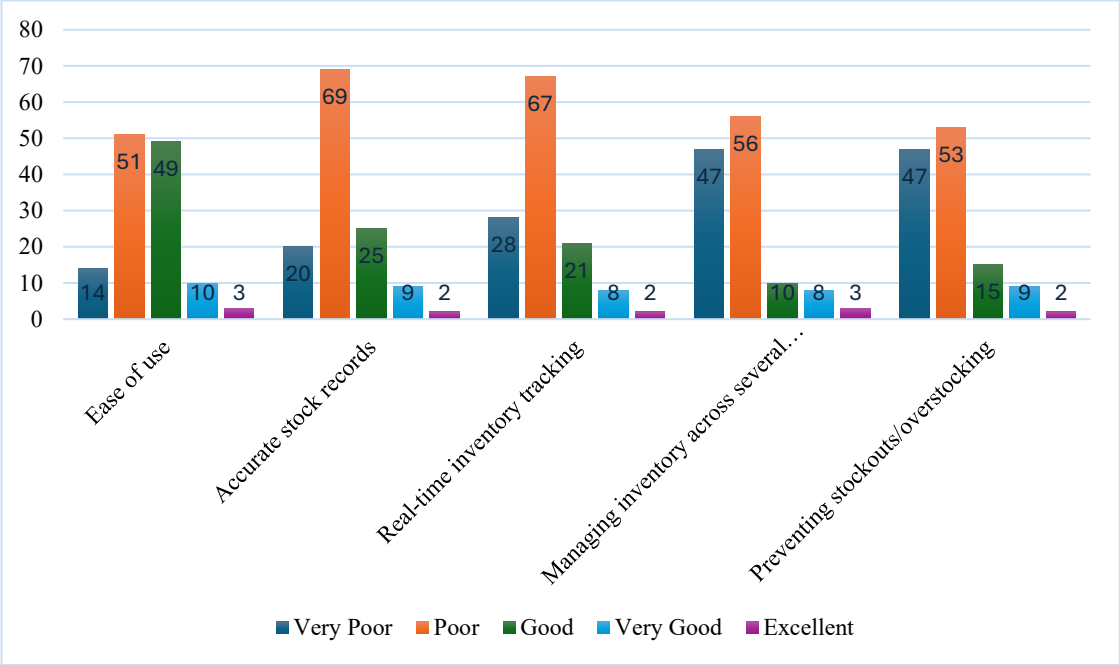

Figure 10: Previous Inventory Management System Features

The above chart (figure 10) shows the response of participants regarding features of previous inventory management systems. A total of 127 responses was obtained. The findings reveal that users were dissatisfied with the reliability of previous systems, with 69 (54%) rated accurate stock records as poor and 20 (15%) as very poor. This indicates that accurate stock records got the lowest ratings overall. With 67 (53%) respondents evaluating real-time inventory tracking as poor and 28 (22%) as very poor, it showed a similar trend, suggesting a significant gap in precise and timely stock visibility. Significant operational challenges in multi-branch coordination were shown by the poor rankings for managing inventory across several branches, which were rated as poor by 56 (44%) respondents and very poor by 47 (37%).

Respondents' ratings of ease of use were mixed; 51 (40%) gave poor rating, while 49 (39%) offered a good rating, revealing that different systems have varying user experiences. Similarly, 53 (42%) respondents scored the prevention of stockouts and overstocking a poor rating, whereas 47 gave it a very poor rating.

The pattern of responses demonstrated that even though certain methods may have worked for simple tasks, they typically lacked the effectiveness, integration, and real-time features needed for current pharmacy operations, highlighting the importance of switching to cloud-based solutions.

4.3.3 What were the main difficulties you experienced with the previous system?

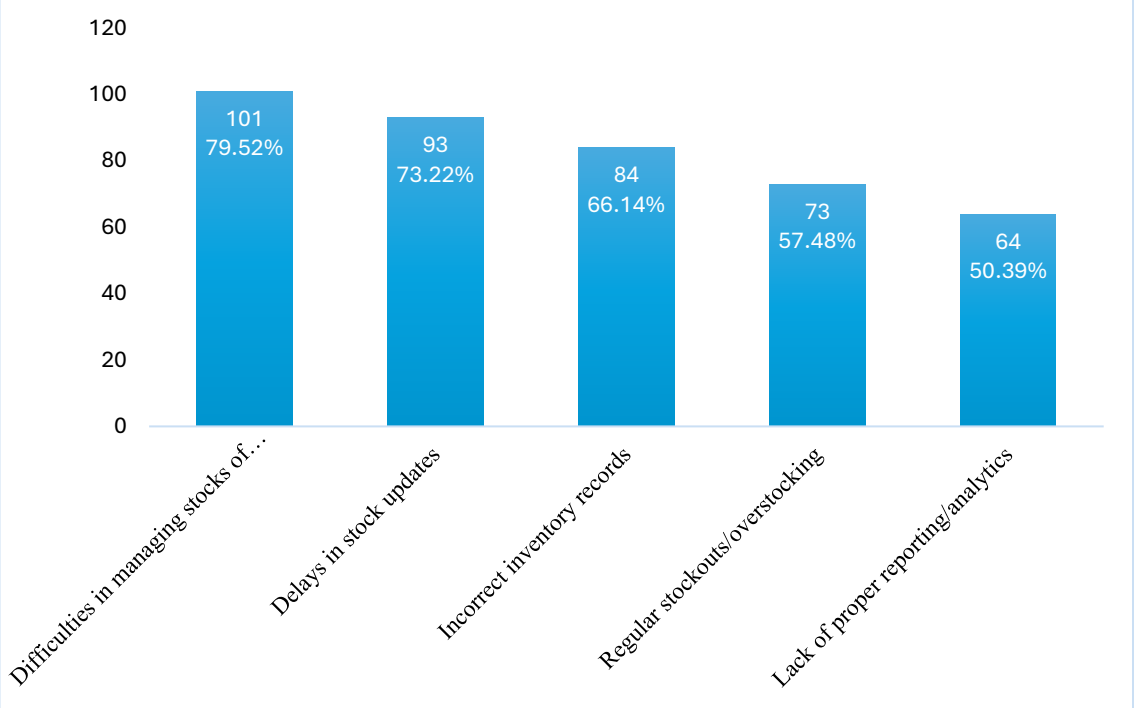

Figure 11: Major Challenges with Previous Inventory Systems

According to figure 11, participants shared their opinions about principal challenges of previous inventory systems. All 127 participants shared their feedback. As evidenced by the results, 101 participants (79.52%) answered that maintaining stocks across different stores was the most frequent challenge they experienced. Subsequently, 93 respondents (73.22%) mentioned stock update delays, while 84 respondents (66.14%) mentioned inaccurate inventory records. Overstocking or frequent stockouts were highlighted by 73 participants (57.48%), whereas 64 respondents (50.39%) complained about inadequate reporting and analysis.

From the findings, it is clear that pre-cloud systems were associated with operational inefficiencies, particularly in immediate stock visibility, data accuracy, and multi-branch coordination. The occurrence of these issues emphasised the need for integrated,

automated, and analytically driven inventory methods to improve precision, flexibility, and data driven decision-making.

4.4 Objective 2 analysis: To assess the key features of cloud-based inventory management systems that help with real-time tracking and stock optimisation

4.4.1 Please rate the importance of the following characteristics in your currently operational cloud-based system:

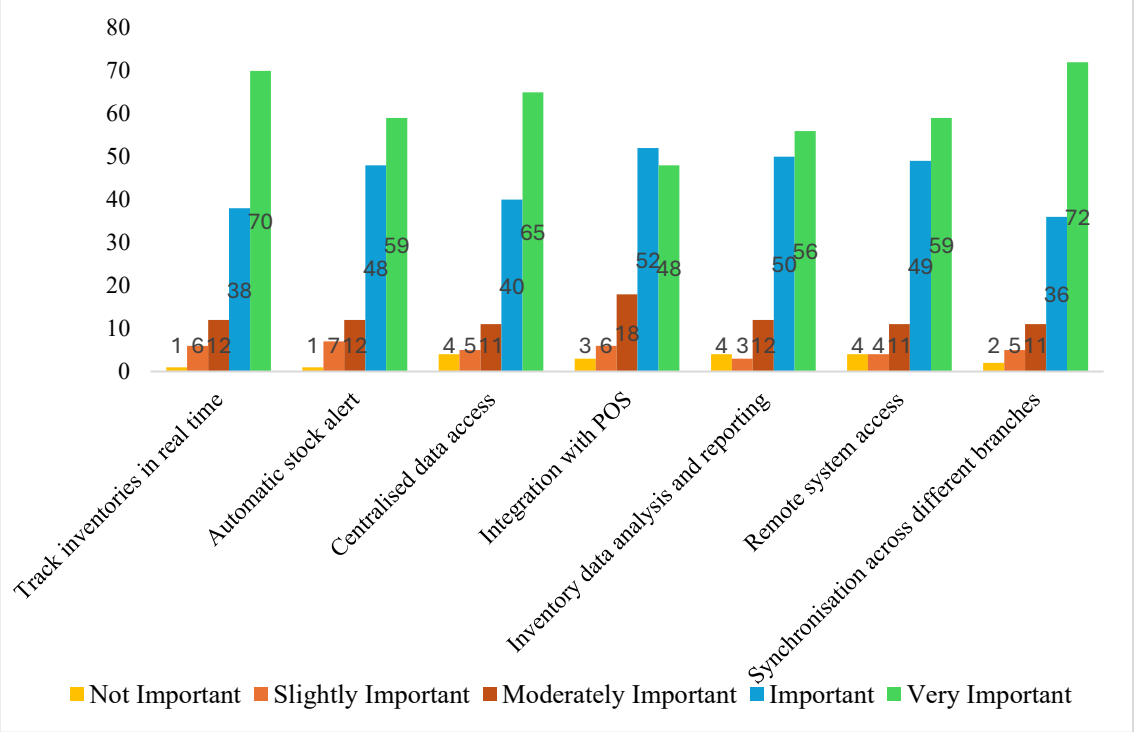

Figure 12: Importance Ratings of Features in CBIMS

According to Figure 12, participants were asked to rate the significance of several features in their existing CBIMS. All the 127 participants expressed their ideas. 72 respondents (57%) rated synchronisation among branches as very important, making it the most valued feature. The high ranking emphasised the importance of smooth communication across group pharmacies where inconsistent data could adversely affect service quality and supply chain efficiency.

The second highest rating was given to real-time inventory tracking with 70 respondents (55%) rating the highest grade, and centralised data access ranked next, with 65 respondents (51%) rated as very important. This indicates that immediate stock visibility must be maintained to ensure medication availability, better demand forecasting, and waste reduction.

Although factors like data analysis/reporting, remote system access, and automated stock alerts were equally highly scored, their comparatively lower significance scores may indicate that users prioritised basic operational functionalities over analytical features.

Notable patterns also emerged from responses in the remaining rating categories. For instance, integration with POS and inventory data analysis were ranked as important, signifying that they were valued but not considered as critical as basic operations. Few respondents (< 5%) gave any feature a not important rating, demonstrating that all features were considered as necessary for CBIMS operations.

4.4.2 How has the cloud-based system influenced your inventory management?

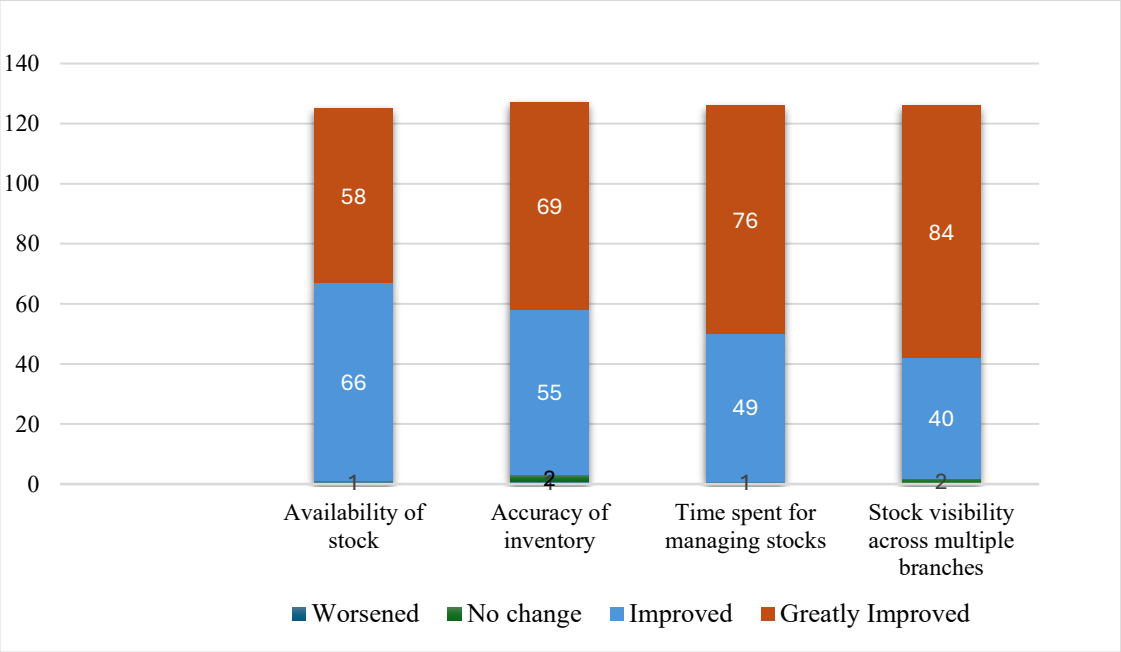

Figure 13: Reports on CBIMS's Effect on Inventory Control

As shown in above graph (figure 13), participants' views on how the cloud-based solution affected their inventory management were examined. A total of 127 opinions were collected regarding various aspects of inventory management. Following the implementation of CBIMS, the majority of respondents indicated improvements in important inventory management areas**.** The most positive response was given regarding stock visibility across several branches, with 40 respondents (32%) reporting it had improved and 84 (66%) reporting it had greatly improved. Significant improvements were observed in the time spent on managing stocks, as 49 respondents (39%) reported it had improved, and 76 respondents (60%) reported it had greatly improved. Inventory

accuracy improved, as reported by 55 respondents (43%) and significantly improved, according to 69 respondents (54%), suggesting that CBIMS substantially reduced variations in stock data. These findings showed that CBIMS significantly improved stock visibility, operating efficiency, and record-keeping accuracy.

4.4.3 How satisfied are you with the real-time tracking features of the current system?

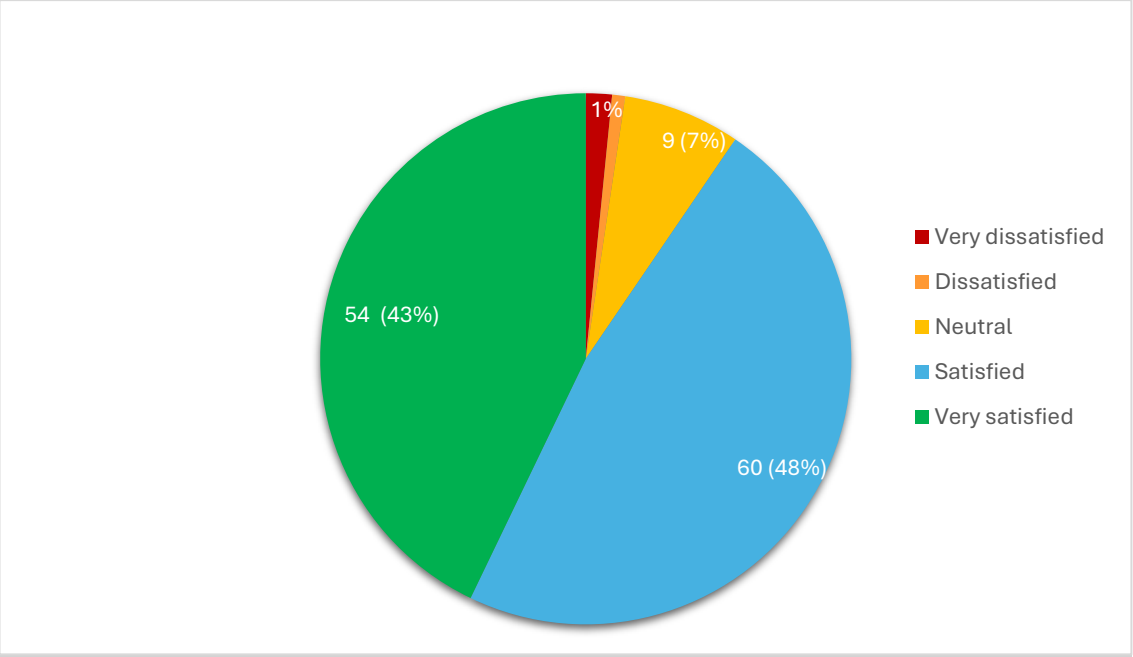

Figure 14: Satisfaction with Real-Time Tracking in CBIMS

Figure 14 shows the opinions of 126 participants about how satisfied they were with the real-time tracking capabilities of the existing system. The majority of respondents had favourable impressions of the real-time tracking feature in their current CBIMS. Nearly half, 60 respondents (48%), reported being satisfied, and 54 respondents (43%) replied they were extremely satisfied.

A smaller percentage of respondents 9 (7%) shared neutral opinions indicating neither satisfaction nor dissatisfaction while a single participant (1%) was extremely dissatisfied. This minimal negative response demonstrates that most customers found the real-time tracking capability helpful in their daily work.

Therefore, these results complement previous findings revealing that instant stock visibility is a valued feature of CBIMS and crucial for customer happiness and the overall efficiency of the system.

4.5 Objective 3 analysis: To evaluate the benefits and challenges of implementing cloud-based inventory management in real-time tracking and stock optimisation across multiple pharmacy locations in the UAE

4.5.1 What benefits have you noticed while using the cloud-based system?

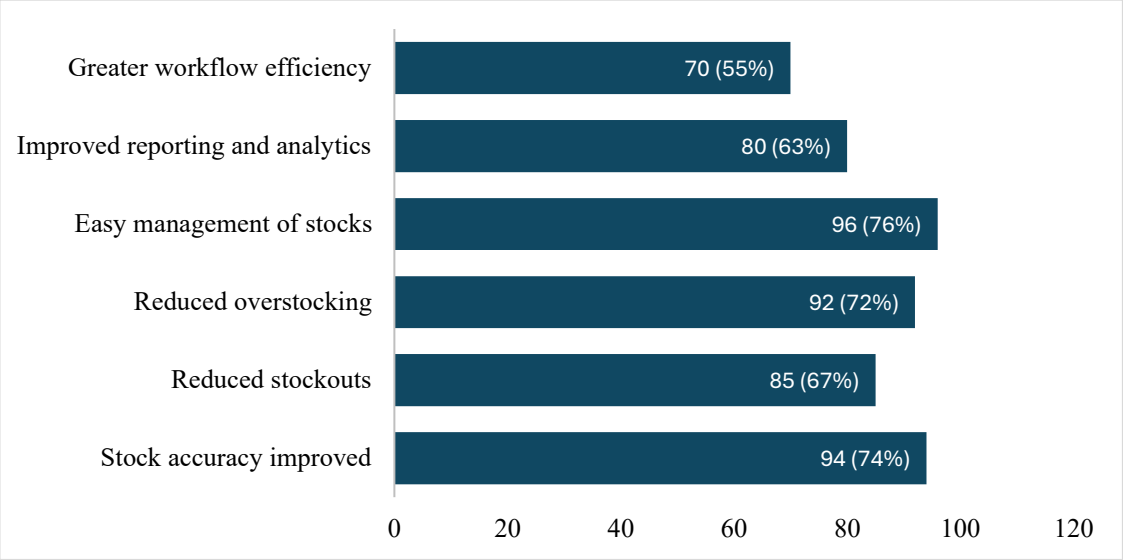

Figure 15 : User-Perceived Benefits of Cloud-Based System

The bar chart (figure 15) summarises the key benefits observed with CBIMS based on input from 127 respondents.The respondents were allowed to select multiple options they considered appropriate. According to 96 participants (76%), the key advantage was the easy stock management capability of CBIMS. This result indicates that technological innovations enabled routine inventory tasks easier, lowering the amount of physical work required for employees. Improved stock accuracy was highlighted by 94 respondents (74%), indicating that CBIMS also helped reduce the difference between reported and real stock, which is important for minimising financial losses and ensuring regulatory compliance.

The results of stock optimisation were significant with 85 participants (67%) indicating improved product availability for consumers, which resulted in improved service quality, while decreased overstocking mentioned by 92 respondents (72%) enable pharmacies to avoid investment in excess stock. These findings collectively demonstrate that the system strengthened restocking plan and demand prediction across multiple branches.

In addition to inventory control, the system's contribution to improving operational decision-making was recognised by the participants. Improved analytics and

reporting stated by 80 respondents (63%) implies that CBIMS allows for better planning and proactive problem-solving. Moreover, increased workflow efficiency expressed by 70 respondents (55%) shows that CBIMS simplified day-to-day operations, enabling employees to concentrate more on serving customers than administrative responsibilities.

In summary, these advantages illustrate that CBIMS is an integrated platform that promotes operational effectiveness, financial optimisation, and customer happiness rather than being a simple inventory management tool.

4.5.2 What challenges have you observed with the cloud-based system?

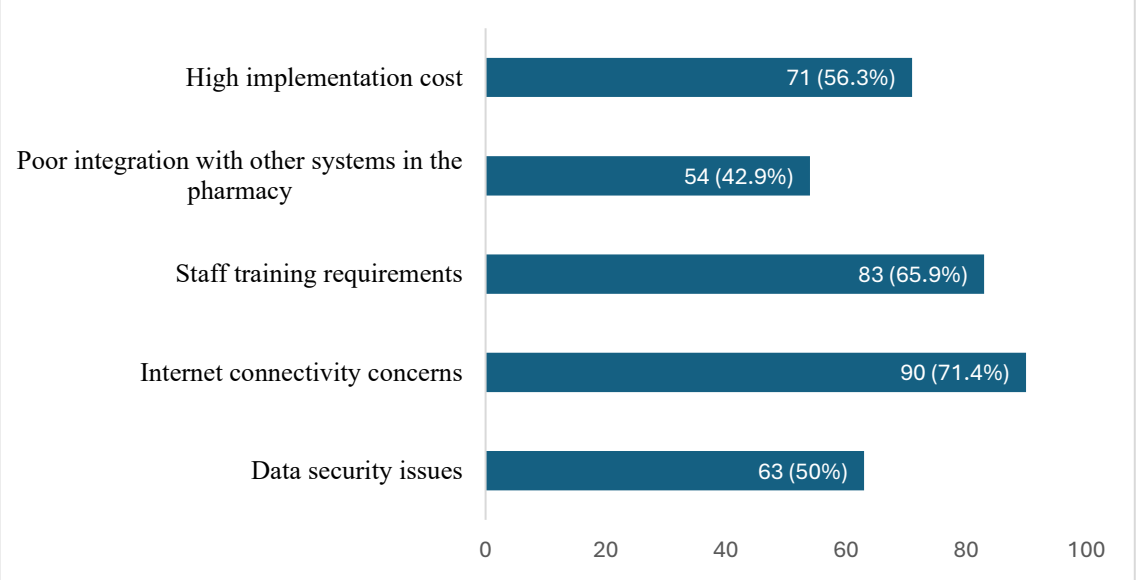

Figure 16: Reported Challenges with CBIMS

The bar graph shown in figure 16 demonstrates participants feedback on the challenges experienced with the CBIMS by choosing all options that reflected their experience. A total of 127 responses were collected and most frequently addressed challenge was internet connectivity indicated by 90 respondents (71.4%), highlighting the system's dependence on stable network connections. Following these, 83 respondents (65.9%) mentioned staff training requirements, suggesting that continuous training is crucial for efficient utilisation.

Subsequently, 71 respondents (56.3%) pointed out high implementation costs, reflecting significant economic constraints for certain businesses. Additionally, data security problems were reported by 63 respondents (50%), and inadequate system integration was highlighted by 54 respondents (42.9%).

These findings demonstrate that although CBIMS has several operational advantages, resolving the specific problems could further improve user satisfaction and popularity.

4.6 Objective 4 analysis: To investigate the potential of cloud-based inventory management to reduce stockouts and overstocking in group pharmacies

4.6.1 How frequently have you experienced stockouts since using the cloud-based system?

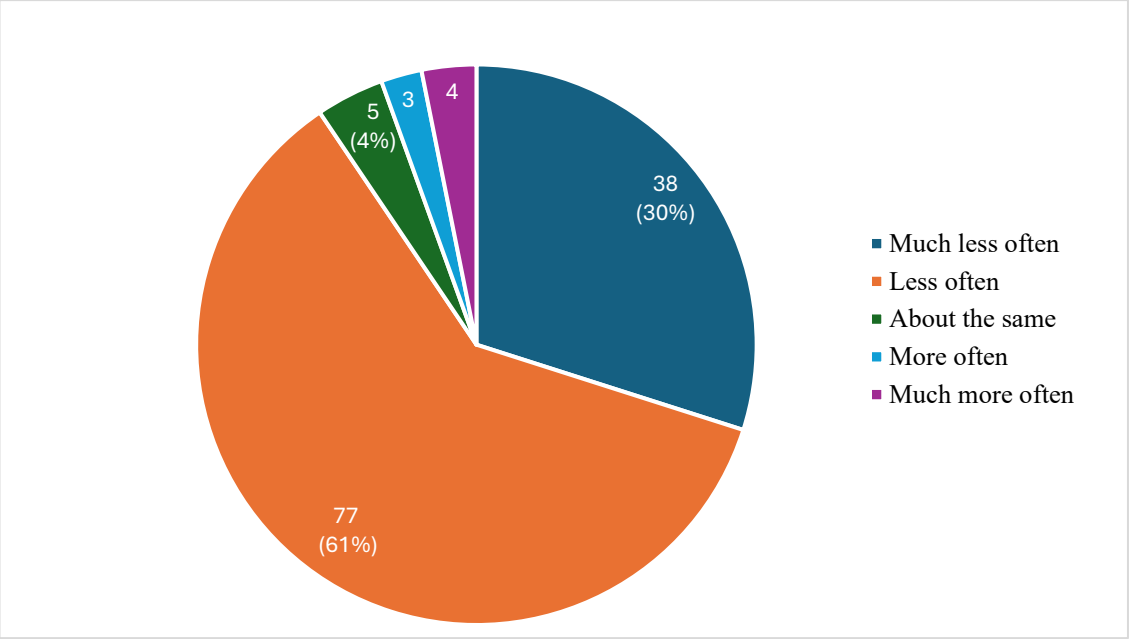

Figure 17: Stockout Frequency After CBIMS Implementation

Figure 17 shows the responses from 127 participants regarding the frequency of stockouts after the CBIMS implementation. Among the participants, 77 (61%) claimed that stockouts were less frequent, while 38 (30%) reported that they occurred considerably less frequently. A smaller proportion of participants reported no noticeable change (5, 4%), more frequent stockouts (3, 2%), or much more frequent stockouts (4, 3%).

With more than 90% of respondents reporting fewer stockouts, this distribution reflects a positive trend, suggesting that CBIMS has played a key role in maintaining the availability of products. Responses such as no improvement or worsening outcomes, shared by a smaller number of participants may indicate operational difficulties like stock handling problems or supplier delays rather than technical limitations.

4.6.2 How frequently have you experienced overstocking since implementing the cloud-based system?

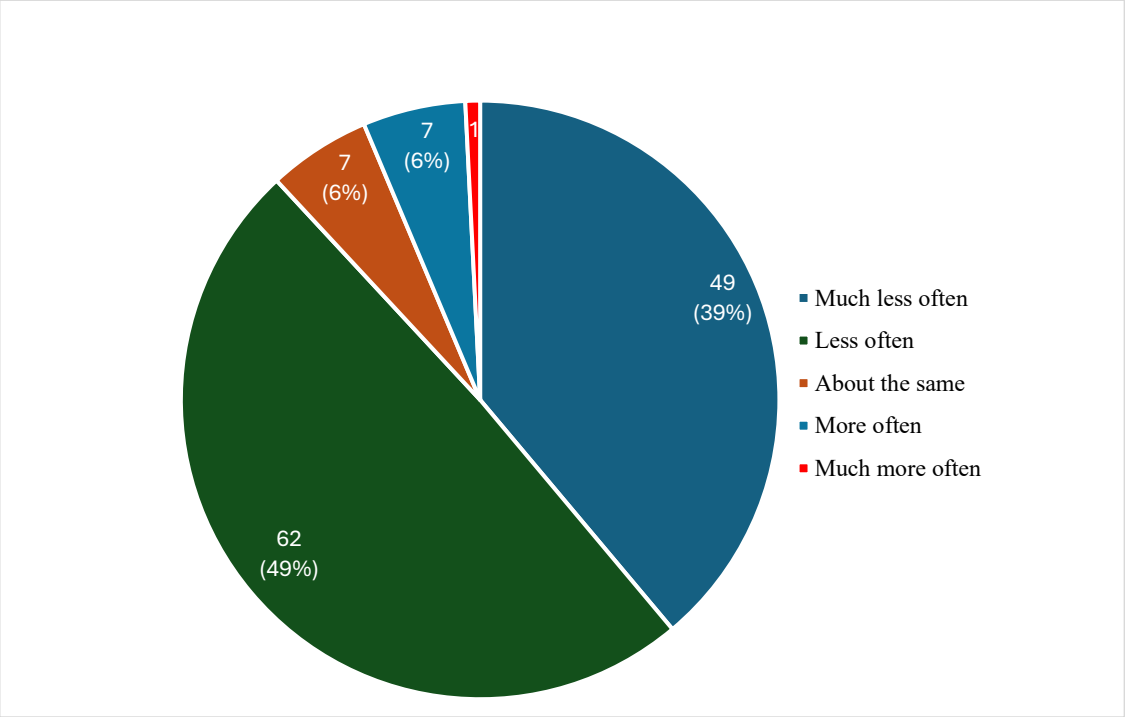

Figure 18: Frequency of overstocking after CBIMS Implementation

In the pie chart above, participants were asked how frequently they experienced overstocking after implementing the CBIMS as shown in figure 18. A total of 126 responses were collected and majority of participants (62, or 49%) indicated less often while 49 participants (39%) mentioned much less often. However, a few participants indicated no change (7 respondents, 6%), more frequent occurrences (7 respondents, 6%), or considerably more frequent occurrences (1 respondent, 1%). This distribution suggests that most of the participants noticed a reduction in overstocking following the implementation of CBIMS.

4.6.3 How efficient is the system in alerting to low or overstocked circumstances?

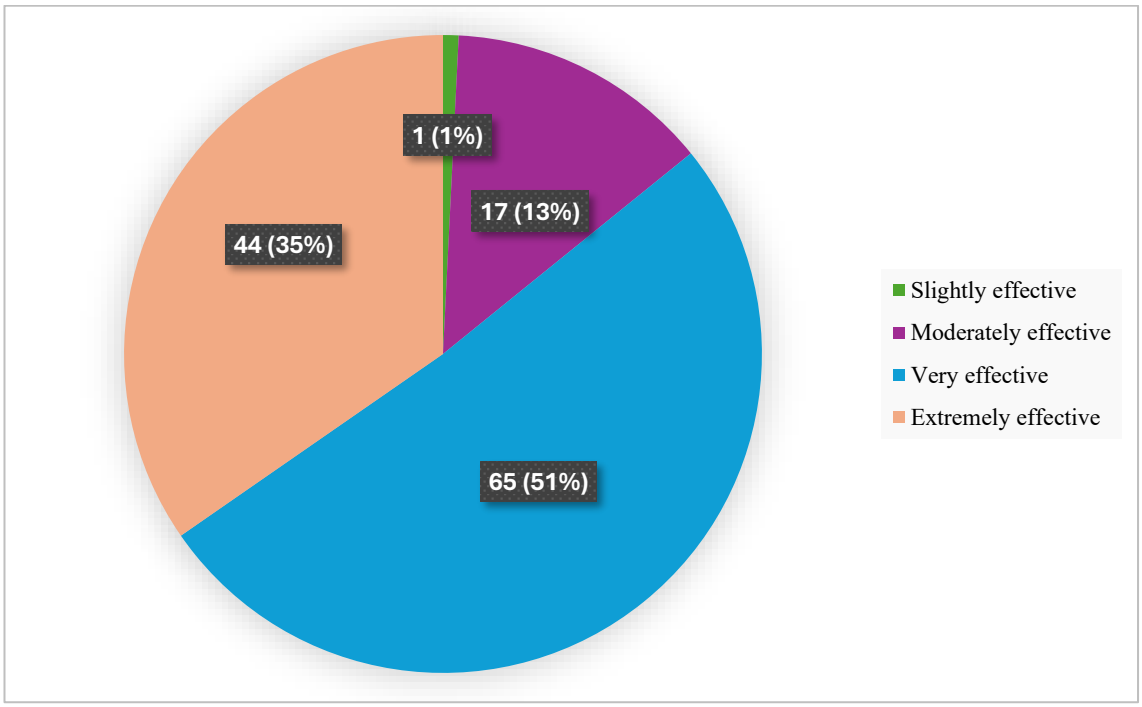

Figure 19: Efficiency of CBIMS in Alerting Low or Overstocked Situations

Participants were asked to rate the efficiency of CBIMS in alerting to low or overstocked situations, and all 127 participants provided their opinions. According to figure 19, 44 respondents (35%) considered the system extremely effective, while 65 respondents (51%) the majority, identified it as very effective. A smaller proportion of respondents (17, or 13%) regarded the system as moderately effective, and a single participant classified it as slightly effective.

In summary, the majority of users consider CBIMS's alerting feature to be extremely beneficial as it provides immediate alerts that help prevent stockouts and overstocking. This capability enables proactive inventory management practices that support the maintenance of optimal stock levels.

4.7 Objective 5 analysis: To assess the experience of pharmacy staff working in group pharmacies regarding the use, effectiveness, and impact of cloud-based inventory management in their daily workflow

4.7.1 How simple was it for you to adjust to the new cloud system?

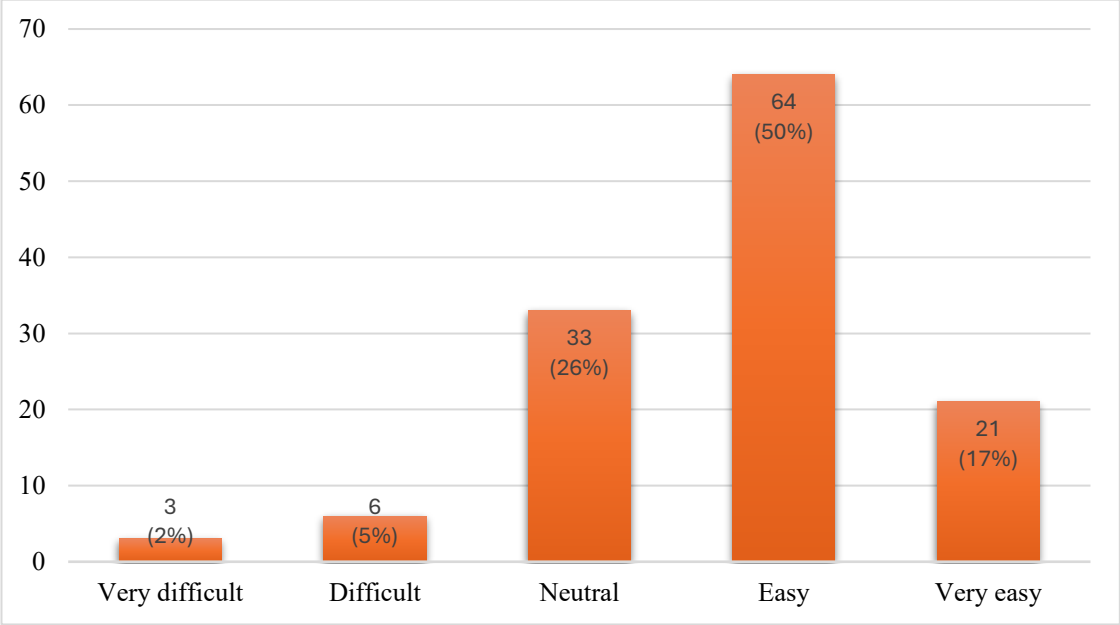

Figure 20: Ease of Transition to the cloud-Based System

Figure 20 demonstrates the participants' opinion regarding ease of adaptation to the current cloud-based system, based on responses from all 127 participants. Majority of responses (64 respondents, 50%), reported that the transition was easy, while 33 respondents (26%) stated that it was neutral. Furthermore, 21 (17%) stated the method was very easy. In contrast, only six participants (5%) indicated that adaption was difficult, and 3 respondents (2%) stated that it was very difficult.

In summary, the results reveal that most users experienced minimal issues when adopting the system into their workflow, suggesting a relatively favourable transition process.

4.7.2 How has the cloud-based system affected your daily work?

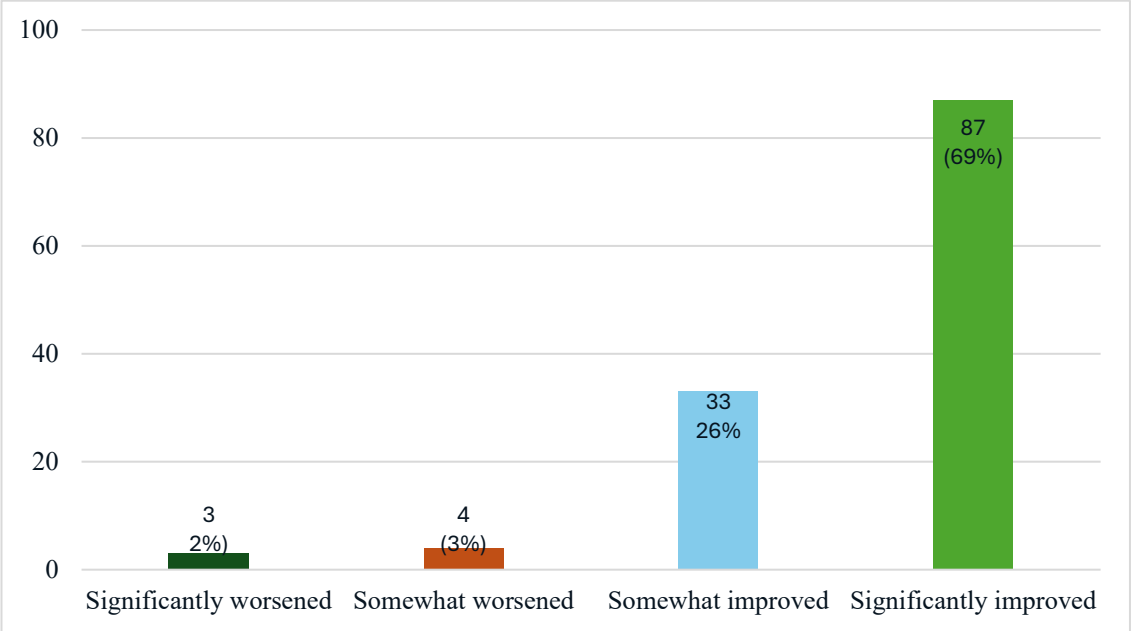

Figure 21: Influence of the Cloud-Based System on Routine Tasks

The above bar chart illustrates responses of 127 participants regarding the impact of cloud systems on their daily work, as shown in figure 21. The majority of respondents (87, or 69%) reported their work situation had significantly improved, while 33, or 26%, stated it had somewhat improved. On the contrary , there were a few unfavourable experiences; 4 participants (3%) reported their work had become somewhat worsened, and 3 (2%) stated it had significantly worsened. These observations suggest that the system has significantly improved performance and administrative convenience for most of the users.

4.7.3 How do you think the cloud-based technology has affected your customer service?

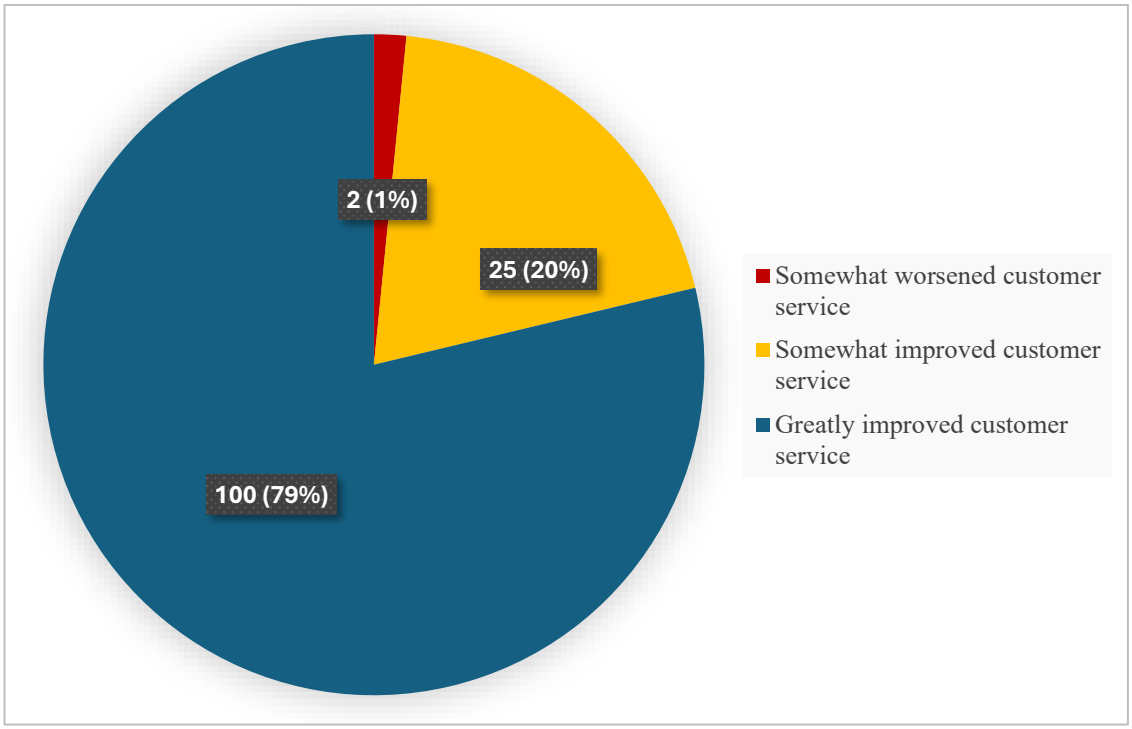

Figure 22: Customer Service Outcomes with the Cloud-Based System

The opinions of all 127 respondents about the impact of the cloud-based technology on customer service in their pharmacies are shown in figure 22. The vast majority of participants 100 (79%), reported that customer service had greatly improved. A further 25 participants (20%) reported that it had somewhat Improved, suggesting less significant benefits. Only 2 respondents (1%), reported that customer service had somewhat worsened. These observations confirm that the system is competent enough to ensure faster service, enhanced stock availability, improved customer responsiveness, thereby optimising service quality.

4.7.4 How satisfied are you with cloud-based inventory management system in your pharmacy overall?

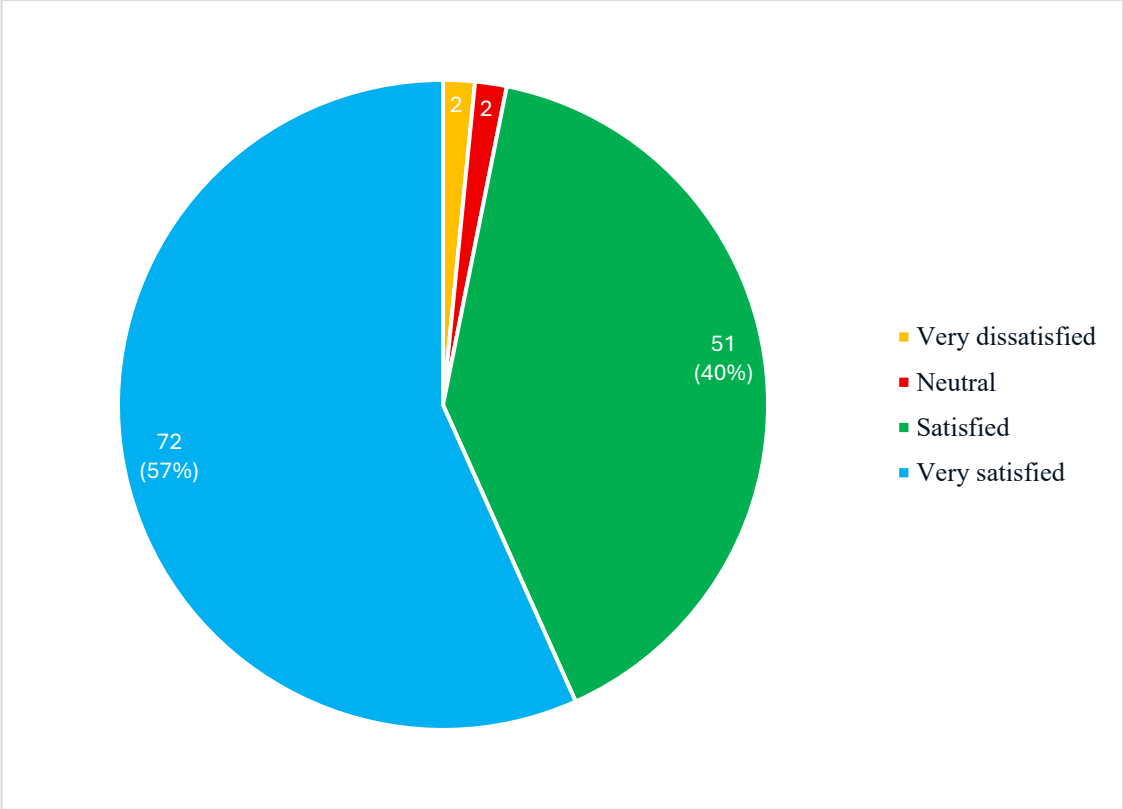

Figure 23: Overall Satisfaction with the CBIMS

The findings shown in figure 23 reveal the proportion of satisfaction with CBIMS among 127 participants. The majority of participants 72 (57%), revealed that they were very satisfied and 51 respondents (40%) stated that they were satisfied with CBIMS. A small number of participants 2 (2%) reported having neutral or very dissatisfied opinion. High satisfaction ratings indicate that by providing real-time data-driven decision making, CBIMS has not only decreased functional delays but also reduced the inventory burden on staff. These findings highlight the system's overall performance and contribute to the study's objectives of illustrating the impact of cloud-based solutions in group pharmacy contexts.

4.8 Thematic Analysis

4.8.1 What do you think is the biggest advantage or limitation of implementing cloud-based inventory management in your organisation?

Table 2: Thematic summary of reported benefits of CBIMS

Main Theme	Responses	Number of Responses
Improved Inventory Control	'Improved accuracy in stock records", "Better tracking of stock levels", "Streamlined inventory processes"	13
Operational Efficiency & Ease of Work	'Faster processes"," Reduced manual workload", "Easier coordination between branches", "Simplified daily operations"	22
Reduced Waste & Errors	'Minimised stock expiry", "Fewer stock discrepancies", "Reduced manual errors"	11
Real-Time Tracking & Automation	'Automatic reordering", "Instant updates on stock status", "Live inventory visibility"	26
Enhanced Stock Visibility & Coordination	'Better branch-to-branch coordination"," Improved stock transfer", "Overall transparency in stock availability"	9

Table 2 provides a summary of the thematic analysis of participant responses to the open-ended question on the key advantages of CBIMS. A total of 81 participants provided feedback. These responses offered a deeper understanding of participant perspectives. Real-time tracking and automation were the most frequently mentioned benefit (26 participants), followed by operational efficiency and ease of work (22 participants). Other significant advantages were enhanced stock visibility and coordination (9 participants), reduced waste and manual errors (11 participants), and improved management of inventory (13 participants). These results suggest that participants rate the highest value for automation, faster operations, and efficient stock management, highlighting operational focus rather than financial focus in the participant evaluation of CBIMS.

Table 3: Thematic summary of reported limitations of CBIMS

Main Theme	Responses	Number of Responses
High Implementation Cost	"High maintenance costs", "Expensive licensing fees"	7
Integration Challenges	"Difficulty in integration with POS", "Connection issues", "System compatibility problems"	2
Internet and Network Dependency Issues	"Delays during network issues", "Stock not updating without internet", "Depends on stable internet connection"	4
Physical Stock Management Requirements	"Need for physical stock checks"	1
Training and Learning Difficulties	" Training required", "Staff need system familiarity"	4
Data Migration Issues	"Data transfer delays", "Data loss during migration"	2

A total of 20 participants shared their opinions on the major limitations of using CBIMS, as summarised in table 3. High implementation cost was the most frequently highlighted drawback (7 participants), demonstrating that financial and technical challenges continue to be more serious than issues with integration or training. Issues with internet and network dependency and training and learning challenges were among the other issues (4 participants). Integration difficulties were mentioned less often by two participants, data migration problems by two participants, and physical stock management requirements by one participant. According to these findings, even though the system provides practical benefits, its wider adoption is affected by barriers such as cost, stable internet connectivity, and employee education.

4.8.2 In your opinion, what improvements should be made to current inventory management system?

Table 4: Thematic summary of suggested improvements for cloud inventory management

Main Theme	Responses	Number of Responses
Forecasting and Demand Prediction	"Better demand forecasting tools", "More advanced predictive analytics"	11
Reporting & Data Export Options	"More reporting formats", "Easy data export to Excel", "Role based reporting options"	11
Integration with External Systems	"Better POS integration", " Sales system connectivity"	11
Offline Access and Connectivity Requirements	"Allow offline access mode"	8
Stock Verification & System Accuracy	"Improve stock accuracy", " Mismatches in physical verification"	3
AI and automation Features	"Add AI-driven reordering", "Automate routine tasks", "Smart expiry alerts"	10
Product Information and Images	"Add product images"	1
Improvements in System Performance and Speed	"Faster system performance", "Reduce loading times", "Optimise performance for large datasets"	6
User Training and Support	"Provide better training", "Continuous customer support", "Ongoing training"	4
Security & Data Protection	"Enhance data security", "Stronger access controls based on role", "Regular security audits"	5
Cost and Affordability Improvement	"Lower subscription cost", "Flexible pricing plans",	2
Customised Options for user	"Customisable dashboards", "User-specific settings", "Customised reports"	6

The thematic analysis of participant recommendations for potential improvements to the current inventory management system is shown in Table 4. A total of 78 respondents reported their opinions. Forecasting and demand prediction, reporting & data export options, and integration with external systems were the commonly reported themes (11 participants each), emphasising the need for better interoperability and analytical capabilities. Ten participants stated that AI and automation features were a major area for development, reflecting a need for advanced, automated procedures.

Security & data protection (5 participants), customised options for users and improvements in system performance and speed (6 participants each), and offline access and connectivity requirements (8 participants) were other prominent themes. A small proportion of participants recommended user training and support (4), stock verification and system accuracy (3), cost and affordability improvement (2), and product information and images requirements (1) tailored to better support their specific task requirements.

In summary, these suggestions demonstrate a strong need for system improvements that improve automation, interoperability, and features in addition to connectivity and personalised features.

4.8.3 Please share any additional comments regarding the use of cloud-based inventory management in your pharmacy:

Table 5: Thematic summary of additional comments on CBIMS usage

Main Theme	Responses	Number of Responses
Improved Efficiency & Productivity	"Faster daily activities", "Improved workflow ", "Efficient time management"	9
Efficient Stock Control & Monitoring	"Accurate stock tracking", "Excellent control over inventory", "Reduced stock variations"	16
Suitability for Multi-branch Operations	"Better coordination among branches", "Easy stock transfer", "Multi-location product visibility"	3
Reduction in Dispensing Errors	"Fewer dispensing mistakes"	1
Positive Overall Experience	"Overall good experience", "System meets expectations",	7
Integration with Other Business Systems	"POS integration required", "Integration with accounting software"	2
Automation & Real-time Features	"Automated reordering needs", "Live inventory updates"	1

A thematic review of additional opinions made by 39 participants on their experiences with cloud-based inventory management is shown in Table 5. Efficient stock control & monitoring (16 participants) was the most frequently highlighted theme, followed by improved efficiency and productivity (9 participants) and positive overall experience

(7 participants) reflecting the operational excellence and workflow efficiency achieved with CBIMS.

Reduction in dispensing errors (1 participant), automation and real-time features (1 participant), integration with other business systems (2 participants), and suitability for multi-branch operations (3 participants) were additional themes provided by the respondents. These responses indicate that participants prioritised enhanced stock visibility and improved efficiency as the most valued aspects of CBIMS.

4.9 Hypothesis

H1: Cloud-based inventory management solutions significantly improve stock optimisation and real-time visibility of pharmaceutical products at chain pharmacies in the UAE.

The hypothesis was tested by assessing the participant responses regarding major operational areas, such as the effectiveness of stock management and real-time tracking capabilities, following the introduction of CBIMS. The perceived impact of the system on pharmacy operations was evaluated using statistical tests to determine whether the ratings demonstrated significant improvement.

Table 6: *Summary of one-sample t-test results for stock optimisation and real-time tracking indices*

Index	N	Mean	Std. Deviation	t	df	p-value	Mean Difference	95% CI Lower	95% CI Upper	Cohen's d
Stock Optimisation Index	127	2.8	0.335	-6.897	126	<.001	-0.2048	-0.2636	-0.1461	-0.612
Real-Time Tracking Index	127	3.44	0.409	12.242	126	<.001	0.4441	0.3723	0.5159	1.086

A one-sample t-test was used to determine whether the Stock optimisation index and real-time tracking index deviated substantially from the neutral baseline score 3. According to the findings, the stock optimisation index (M = 2.80, SD = 0.34) had a medium-to-large negative impact size (d = -0.612) and was significantly lower than the test value, t(126) = -6.897 with p <.001. The analysis suggests that the respondents did not experience significant improvement in stock optimisation following the implementation of cloud-based inventory management systems. On the contrary , the real-time tracking index (M

= 3.44, SD = 0.41) had a significant favourable effect size (d = 1.086) and was considerably higher than the test value (t(126) = 12.242, p <.001), revealing significant perceived improvement in real-time stock visibility.

With strong evidence of improvement in real-time tracking, yet no improvement in stock optimisation, the findings partially support the hypothesis that cloud-based inventory systems significantly improve stock optimisation and real-time visibility in chain pharmacies in the UAE.

Table 7: Descriptive statistics of Stock Optimisation and Real-Time Tracking Features

Descriptive Statistics			
Variable	**Mean**	**Std. Deviation**	**N**
Stock Optimisation Components			
Availability of Stock	3.45	0.546	125
Accuracy of Inventory	3.51	0.576	127
Time Spent for Managing Stocks	3.59	0.541	126
Stock Accuracy Improved	0.74	0.44	127
Reduced Stockouts	0.68	0.469	127
Reduced Overstocking	0.72	0.452	127
Stockout Frequency	4.12	0.842	127
Overstocking Frequency	4.2	0.839	126
Real-Time Tracking Components			
Track Inventories in Real Time	4.34	0.893	127
Stock visibility Across Multiple Branches	3.65	0.511	126
Real-Time Tracking Satisfaction	4.29	0.77	126
Easier Management of Stocks across Multiple Branches	0.75	0.436	127
Alerting Efficiency in Low or Overstocked Circumstances	4.2	0.691	127

The descriptive statistics for the variables used for evaluating the stock optimisation and real-time tracking are shown in Table 7. The mean scores for the stock optimisation components varied from 0.68 (reduced stockouts) to 4.20 (overstocking frequency), suggesting different levels of perceived impact. Overstocking frequency (M = 4.20, SD = 0.839) and stockout frequency (M = 4.12, SD = 0.842) showed the highest means, reflecting continuous tracking and reporting of stock variations. Among the real-time

tracking components, track inventories in real time had the highest mean (M = 4.34, SD = 0.893), indicating a strong capacity to monitor inventories continuously. Overall satisfaction with the system's tracking capabilities was demonstrated by high scores for stock visibility across several branches (M = 3.65, SD = 0.511) and real-time tracking satisfaction (M = 4.29, SD = 0.770). Sample size (N) variations across variables indicate occasional non-responses to certain survey questions.

Table 8: Pearson correlation analysis

Variables	Pearson's r	Significance (2-tailed)	N
Stock Optimisation Index and Real Time Index	0.633	<0.001	127

A statistically significant positive correlation between stock optimisation and real-time tracking indices was found by the Pearson correlation analysis ($r = 0.633$, $p < 0.001$, $N = 127$), suggesting that improvements in real-time visibility are directly linked to improvements in stock optimisation. The result support the study's hypothesis that cloud-based solutions significantly improve stock optimisation and product visibility in the UAE group pharmacies.

Table 9: Chi-Square analysis of the relationship between role and perceived improvement in stock accuracy

Role	Stock Accuracy Improved (No)	Stock Accuracy Improved (Yes)	Total	Percentage (Yes)
Pharmacist (N = 91)	24	67	91	73.6 %
Pharmacy Manager (N = 36)	9	27	36	75 %
Total	33	94	127	

Table 10: Summary of chi-square test

Test Statistic	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	0.025	1	0.874
Likelihood Ratio	0.025	1	0.873
Linear-by-Linear Association	0.025	1	0.874
Number of Valid Cases	127		

The chi-square test revealed no statistically significant correlation (X^2 (1,N = 127) = 0.03, p = 0.874) between job role and the opinion that stock accuracy had increased after the cloud-based inventory management system as shown in table 10 with p value 0.874. Pharmacy managers (75.0%) and pharmacists (73.6%) expressed a similar level of CBIMS acceptance, suggesting that perceived improvements in stock accuracy were consistent across roles.

Table 11: Chi-square analysis of the relationship between real-time tracking satisfaction and efficiency of stock alerting

Real-Time Tracking Satisfaction	Stock Alerts (Not Efficient)	Stock Alerts (Moderately Efficient)	Stock Alerts (Highly Efficient)	Total
Dissatisfied	0 (0%)	0 (0%)	3 (100%)	3
Neutral	0 (0%)	6 (66.7%)	3 (33.3%)	9
Satisfied/Very Satisfied	1 (0.9%)	10 (8.8%)	103 (90.4%)	114
Total	1 (0.8%)	16 (12.7%)	109 (86.5%)	126

Table 12: Table of chi-square test for real- time tracking features

Test	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	25.713	4	<0.001
Likelihood Ratio	16.802	4	0.002
Linear-by-Linear Association	5.553	1	0.018
Number of Valid Cases	126		

Real-time tracking satisfaction and alerting efficiency in the CBIMS were compared using the chi-square test. According to the findings shown in table 12, there was a statistically significant association (X^2 (4, N = 126) = 25.71, p < 0.001) between participants' satisfaction with real-time tracking and their opinion of the system's effectiveness in notifying low or overstocked conditions .

In summary, the findings indicate that, although stock optimisation was not statistically significant, it is likely to be influenced by real - time tracking, with no differences among job roles.

4.10 Discussion

This section compares the study's findings with the literature discussed in Chapter two and analyses them in the context of the research objectives. The analysis provides insightful evidence on how cloud-based inventory management systems assist multi-location pharmacies in the UAE in improving stock management, real-time visibility, and operational efficiency.

Objective 1: To examine how retail chain pharmacies managed their inventory before implementing cloud-based solutions

The study found that Excel spreadsheets, manual, paper-based systems, and on-premises software were the most common inventory management technologies used before cloud adoption. A significant percentage of participants (83%) mentioned utilising local software, which provided a certain amount of digital assistance but lacked interoperability and immediate access to inventory data. This supports the challenges emphasised by Dharaniya et al. (2024) and Gaoual et al. (2025), who noted that decentralised systems

often lead to delays, communication difficulties between branches, and stock irregularities.

Among the participants, 15% reported using spreadsheets. Although they offered a structured alternative to paper, they were not appropriate for large-scale, multi-location businesses since they lack automatic functions and were prone to data entry mistakes. The results complement the findings provided by Jaju et al. (2023), who observed similar inefficiencies in healthcare organisations that rely on manual updating and basic reporting techniques.

The use of entirely manually operated processes was limited to 2% of respondents, which is exceptional and reflects operational models that are prone to human error and delayed information flow. Participants highlighted several issues with all of the pre-cloud system types, including difficulties maintaining stock levels across branches (79.5%), delays in stock updates (73.2%),overstocking or frequent stockouts (57.5%), and insufficient reporting and analytics (50.4%). These challenges demonstrated the inefficiency of traditional inventory methods to offer precise, timely, and consolidated information, which decreased operational effectiveness and increased inventory handling risks. This indicates the significance of this study in driving transition towards cloud- based systems based on practical evidence.

Objective 2: To assess the key features of cloud-based inventory management systems that help with real-time tracking and stock optimisation

According to the analysis of this objective, participants provided the highest priority to features directly associated with real-time tracking and stock optimisation. Majority of the participants rated features such as synchronisation across branches (85%), tracking inventories in real time (85%), centralised data access (83%) and automatic stock alerts (84%) as important or very important. These findings match the advantages mentioned by Jenkins (2025) and Akter (2024), who found that branch-level synchronisation, timely updates, and live tracking were the main variables that improved stock accuracy and decreased waste.

Additionally, the importance rated on inventory data analysis (83%), POS integration(78%), and centralised data access (83%) is in accordance with Ogbewele, Mbata, and Nwosu's (2024) framework, which incorporates various sources of data to improve operational efficiency.

Significantly high levels of satisfaction were reported by 91% of respondents, indicating that they were either satisfied or extremely satisfied with the real-time features offered by CBIMS. This is consistent with the findings of Ugbebor et al. (2024), who demonstrated that automation and real-time updates greatly enhance stock control and minimise staff workload. The relatively low levels of dissatisfaction (2%) suggest that implementation issues, such as those observed by Ale et al. (2025) regarding employee adaptability with mobile solutions, have been effectively addressed in the participating pharmacies.

Several inventory control parameters have significantly improved with the introduction of CBIMS. Many respondents indicated improvements or significant improvements in stock availability, inventory accuracy, reduction in time spent for maintaining stock, and product visibility across multiple locations. These results validate findings of Shashi (2023), who observed that real-time, centralised systems eliminate delays in stock distribution and coordination across multi location retail stores.

In summary, the results indicate that the features offered by CBIMS are consistent with previous studies, offering quantifiable benefits in the UAE retail pharmacy stores to enhance performance.

Objective 3: To evaluate the benefits and challenges of implementing cloud-based inventory management in real-time tracking and stock optimisation across multiple pharmacy locations in the UAE

The survey results of the study support the majority of the benefits of cloud-based inventory management systems mentioned in the literature. Significant improvements in operational efficiency were pointed out by respondents with 76% stating easy stock management, 74% reporting improved stock accuracy , and over 70% indicating reduced overstocking and stockouts. The observed improvements in analytics and workflow efficiency (63%) are consistent with the analysis of Gupta et al. (2023) who identified the importance of centralised, multi-branch product visibility options for effective stock redistribution and waste reduction. Thematic findings further confirm these results, as participants rated automation and real-time tracking as the most significant benefits of CBIMS.

However, 56.3% of respondents noted high implementation costs, and 71.4% mentioned internet access as a barrier, which is similar to the findings of Chebet and Mbandu (2024) regarding infrastructure reliance. The need for staff training, as mentioned by 65.9% of

participants, supports Kartikasari's (2024) finding that lack of training and education could limit adoption and reduce the potential benefits of the system. Issues highlighted by Saha and Rathore (2024) and George and Elrashid (2023) on interoperability and cyber threats in healthcare settings are further supported by the survey responses indicating data security concerns (50%) and integration challenges (42.9%). These quantitative findings correlate with thematic opinions that identified high implementation costs and dependence on a reliable network as major challenges.

According to the survey responses, while CBIMS implementation in UAE pharmacies offers benefits that are consistent with global studies, its success depends on eliminating obstacles through employee training, secure platforms, and easy integration.

Objective 4: To investigate the potential of cloud-based inventory management to reduce stockouts and overstocking in group pharmacies

The use of CBIMS in UAE chain pharmacies has demonstrated a substantial reduction in overstocking and stockouts. Results revealed that 88% of respondents observed similar decreases in the incidence of overstocking, and 91% reported stockouts occurring less frequently or significantly less frequently following implementation. This supports the findings of Leto (2025) and Vangari (2025), who argue that AI-driven forecasting, immediate stock visibility, and automated restocking greatly enhance inventory control, save holding costs, and increase customer satisfaction.

According to the findings, CBIMS has improved stock management across several sites and enhanced supply chain resilience, resulting in a positive operational impact. An eample of CBIMS interface demonstarting these features is provided in Appendix C. Although these benefits have been addressed in general contexts without being validated in the UAE, the current findings offer practical evidence for their relevance in the region.

Objective 5: To assess the experience of pharmacy staff working in group pharmacies regarding the use, effectiveness, and impact of cloud-based inventory management in their daily workflow

According to the study's findings, CBIMS has significantly improved the customer experience, productivity, and staff satisfaction in UAE group pharmacies. More than half of respondents (67%) found the system easy or very easy to adjust with, indicating that the transition phase was simple and well-supported. The findings are similar to Shen et

al. (2024), who emphasise that cloud-based inventory systems streamline processes and decrease manual labour, freeing up employees to engage in patient-centered initiatives.

Noticeable improvements were also shown in pharmacy routine tasks, as 69% of participants claimed their everyday duties had greatly improved, and another 26% indicated they had somewhat progressed. In addition, participants reported the systems impact on customer service. Among the participants 79% stated that it had greatly improved and 20% reported that it had improved to some extent highlighting the importance of centralised management and real-time data availability in improving responsiveness to consumer demands.

Thematic analysis of open-ended responses regarding suggestions for CBIMS improvement revealed a strong need for improvements in automation, integration, and forecasting capabilities, corresponding to the priorities emphasised by Ugbebor et al. (2024) presented in their research on cloud inventory systems enabled by IoT.

The study findings align with literature that highlights how the CBIMS can standardise procedures and provide immediate access to precise, up-to-date inventory information across several regions. Therefore, CBIMS improves customer satisfaction and staff efficiency by improving procedures, reducing manual labour, and guaranteeing better product availability.

Hypothesis: The hypothesis that CBIMS significantly improve stock optimisation and real-time visibility in UAE chain pharmacies was partially supported by the study findings. The one-sample t-test demonstrated significant improvement in real-time tracking ($p < 0.001$), whereas no improvement in stock optimisation. This aligns with literature findings that primary benefits of CBIMS are observed in product visibility and tracking rather than stock optimisation, which requires comprehensive workflow integration. Furthermore, the chi-square association and a significant correlation between tracking and optimisation support earlier findings that improved visibility may eventually contribute to optimisation.

4.11 Summary

In conclusion, although CBIMS adoption in multi-location pharmacies in the UAE demonstrates noticeable advantages including better stock control, real-time visibility and

improved service delivery, several barriers remain to be addressed. The survey analysis revealed distinct patterns and trends that provide valuable information about the efficiency and real-world applications of the cloud-based inventory system. Additionally, the study showed significant associations between the responses of the participants and the broader context described in the existing literature. The importance of automated processes, interoperability, and better prediction accuracy were further emphasised in open-ended answers, which also included recommendations for system upgrades. Finally, the study findings suggest that CBIMS could revolutionise pharmacy operations if its advantages are maximised and implementation challenges are effectively addressed.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusion

This study aimed to examine the impact of cloud-based inventory management solutions (CBIMS) on operational optimisation in retail chain pharmacies in the United Arab Emirates, with a focus on their role in stock optimisation, real-time product tracking, and workflow efficiency. The study offered valuable insights into operational benefits and limitations of CBIMS adoption through an online survey of 127 registered pharmacy professionals. The results support UAE's broader digital healthcare transformation by providing evidence on their impact on regular pharmacy operations.

Objective 1: Inventory Management Before Cloud Adoption

Objective one examined the inventory management practices of retail chain pharmacies before using cloud-based solutions. The results indicate that traditional inventory approaches such as manual or semi-digital, are associated with inadequate branch coordination, low stock accuracy, and poor real-time stock visibility. These findings confirm that pre-cloud systems contribute to stock discrepancies and operational inefficiencies, addressing research question one on the impact of conventional inventory management methods on stock accuracy and operating efficiency in UAE chain pharmacies.

Objective 2: Primary Features Supporting Stock Optimisation and Tracking

The second objective identified the essential components of CBIMS that facilitate stock optimisation and real-time tracking, yielding positive outcomes, and addresses research question two regarding the features of cloud inventory practices valued by pharmacy employees. According to the findings, unified data access, real-time inventory tracking, and branch synchronisation are the key features of cloud-based systems that enhance real-time visibility and operational effectiveness. High satisfaction scores for improvements in accuracy, effectiveness, and coordination demonstrate that these features are essential for maximising inventory control in chain pharmacies in the UAE. These findings emphasise the importance of prioritising such capabilities to improve inventory management performance across multiple branches.

Objective 3: Benefits and Challenges

The third objective, which evaluated the advantages and difficulties associated with CBIMS in stock optimisation and real-time tracking , was achieved with mixed outcomes. CBIMS was widely recognised for its enhancement in stock visibility, accuracy, workflow efficiency, and operational decision-making. However, some recurrent challenges such as reliance on stable network, high installation costs, staff training needs, and integration issues were also highlighted. Thematic analysis confirmed similar findings, with participants identifying high prices, connectivity problems, and training needs as primary challenges and real-time tracking ,automation and operational efficiency as the key advantages. Hence, these findings contribute to answering research question three, demonstrating that although CBIMS offers significant operational advantages, technological, financial, and personnel limitations must be addressed to maximise performance.

Objective 4: Impact on Stockouts and Overstocking

The study findings verify that the goal of objective four has been achieved, indicating that CBIMS significantly lower stockouts and overstocking in UAE retail pharmacy networks. According to the survey results, proactive stock control reduces shortages and surplus inventory by using features like real-time inventory tracking, automatic stock refill alerts, and accurate demand predictions. Consequently, this analysis answers research question four by offering practical insights into effective use of CBIMS to overcome inventory issues and ensure consistent product availability.

Objective 5: Impact on Workflow and Staff Experience

Objective five has been accomplished with a comprehensive understanding of staff experiences with CBIMS in group pharmacies. Better customer service, easier transitions, and improved workflows were reported through high satisfaction ratings from the majority of respondents, reflecting that the system is sufficient to improve productivity and minimise operational constraints. Open-ended responses highlighted areas for improvement in forecasting, integration, and automation, while also emphasising the importance of integration and stock control competencies. These outcomes fulfil research question five by demonstrating that the adoption of CBIMS has a strong positive effect on employees' daily duties and responsibilities, ultimately promoting operational excellence and superior customer service across chain pharmacies.

Hypothesis Testing

The hypothesis proposed that CBIMS would significantly improve real-time tracking and stock optimisation in chain pharmacies across the UAE. The statistical analysis demonstrated a significant enhancement in real-time tracking; However, no corresponding improvement was observed in stock optimisation, indicating that the hypothesis was only partially supported. A strong positive correlation between the two indices highlights the need for further efforts to address factors limiting stock optimisation while maintaining the proven benefits of real-time visibility.

5.2 Comparison with Existing Literature

Although previous studies (e.g., Chebet & Mbandu, 2024; Kartikasari, 2024) demonstrated the benefits of CBIMS in improving stock accuracy, operational efficiency, and real-time visibility, this study offers recent evidence from the UAE retail chain pharmacy context. Along with demonstrating high levels of employee satisfaction and relatively easy adoption, the results support previous studies indicating that centralised and automated systems improve inventory control and reduce stockouts. Furthermore, in contrast to previous studies that mainly focus on hospitals or major healthcare networks, this study demonstrates that CBIMS can provide comparable operational and service quality enhancements in geographically distributed community pharmacy settings. Additionally, the findings provide new insights into the necessity of forecasting tools, interoperability, and AI-driven automation, while also supporting concerns in the literature regarding limitations related to cost, connectivity, and integration. Future advancements should integrate technology with appropriate training, adaptability , and cost-effectiveness to create a lasting impact on pharmacy networks.

5.3 Study Limitations

Although the study offers valuable insights into the implementation and impact of CBIMS in chain pharmacies in the UAE, it is important to acknowledge significant limitations. Only 127 responses were received out of the expected sample size of 358, which may limit the generalisability of the findings. The number of responses varied between 125 and 127 because some participants did not answer all the questions. The research focused exclusively on pharmacy professionals using CBIMS therefore, the perspectives of non-users were not collected. Additionally, the results may not be transferable to other

locations or pharmacy models due to the study's focus on specific geographic and operational setting.

5.4 Recommendations

5.4.1 Practical Recommendations

According to the results, the following practical steps are recommended:

- Integrate automated reordering and AI-driven forecasting features to improve inventory balance and enhance the precision of demand forecasts.
- Improve interoperability and connectivity by integrating with pharmacy operational systems, while also providing offline access during network disruptions.
- Provide continuous training for employees on system features, upgrades, and troubleshooting to enhance adoption and decrease errors.
- Strengthen data security and compliance by implementing role-based access restrictions, conducting frequent security audits, and adhering to UAE healthcare data regulations.

5.4.2 Recommendations for Future Research

- Conduct comparative studies of stock optimisation, operational efficiency, and real-time tracking accuracy between pharmacies utilising CBIMS and those relying on traditional inventory systems.
- Examine the digital literacy levels of employees in CBIMS acceptance, specifically across various age groups and roles within the pharmacy team.
- Assess the impact of CBIMS on patient outcomes, such as increased medicine availability, reductions in dispensing delays, and improved customer satisfaction.
- Further exploration into the integration of CBIMS with AI-driven demand forecasting technologies to enhance predictive stock replenishment in multi-store networks.

5.5 Final Reflection

Completing this dissertation has been an incredible experience, providing valuable insights into optimising pharmacy operations through digital technologies. Examining cloud-based inventory management systems in the UAE has strengthened my understanding of how adopting digital technologies can increase stock accuracy, eliminate operational inefficiencies, and enable real-time decision-making. In addition to academic learning, this process has strengthened my competence in critical assessment, data analysis, and research planning.

REFERENCES

Adirektawon, S., Theeraroungchaisri, A. and Sakulbumrungsil, R.C. (2024) (3) 'Efficiency of Inventory in Thai Hospitals: Comparing Traditional and Vendor-Managed Inventory Systems'. *Logistics*, 8(3), p. 89. DOI: 10.3390/logistics8030089.

Ahmed, M., Mohamad, A. and Iskandar, F. (2023) 'Big Data Factors Toward Enhancing United Arab Emirates Drug Inventory Management System for Effective Decision-Making'. *International Journal of Business Society*, 7(9).

Ahmed, S.K. (2024) 'How to Choose a Sampling Technique and Determine Sample Size for Research: A Simplified Guide for Researchers'. *Oral Oncology Reports*, 12, p. 100662. DOI: 10.1016/j.oor.2024.100662.

Akter, A.K. (2024) 'Optimizing Hospital Pharmacy Inventory Management Systems: Challenges and Solutions'. *Journal of Pharmacist and Hospital Pharmacy*, 1(1), pp. 07–10. DOI: 10.33545/30790522.2024.v1.i1.A.3.

Ale, Y. *et al.* (2025) 'IoT in Revolutionizing the Pharmaceutical Sector: Applications and Challenges'. *Biomedical and Pharmacology Journal*, 18(March Spl Edition), pp. 1–15.

Ashemore, A.W. *et al.* (2023) 'Understanding the Problem of Digital Medication Inventory Visibility in Health Systems'. *American Journal of Health-System Pharmacy*, 80(18), pp. 1255–1263. DOI: 10.1093/ajhp/zxad130.

Azdan. (2024) *NetSuite for Pharmaceuticals Distribution: An Ultimate Guide*. Available at: https://www.azdan.com/netsuite-for-pharmaceuticals-distribution/ (Accessed: 11 July 2025).

Balar, Y. (2024) *AI-Powered Pharmacy Software System for Inventory Management*. *Healthray*. Available at: https://healthray.com/blog/pharmacy-management-system/ai-powered-pharmacy-software-systems-improve-inventory-management/ (Accessed: 19 February 2025).

Belski, V. (2024) *Healthcare IT Landscape in UAE*. Available at: https://belski.me/blog/healthcare_it_landscape_in_uae/ (Accessed: 4 August 2025).

Byrne, D. (2022) 'A Worked Example of Braun and Clarke's Approach to Reflexive Thematic Analysis'. *Quality & Quantity*, 56(3), pp. 1391–1412. DOI: 10.1007/s11135-021-01182-y.

Chebet, K. and Mbandu, V. (2024) (6) 'Cloud-Enabled Machine Learning: A Framework for Revolutionizing Pharmacy Inventory Management in Nairobi County'. *International Journal of Professional Practice*, 12(6), pp. 15–27. DOI: 10.71274/ijpp.v12i6.457.

Chloe, R. (2023) *Cloud-Based Inventory Management System: All About It*. *TagSamurai*. Available at: https://www.tagsamurai.com/what-is-cloud-based-inventory-management-system/ (Accessed: 17 March 2025).

Choudhary, S. (2024) ‘Inventory Optimization Using an AI-Powered Holistic Model for Decision-Support System’. *International Journal for Research in Applied Science and Engineering Technology*, 12(3), pp. 414–421. DOI: 10.22214/ijraset.2024.58732.

Credence Research. (2025) *UAE Retail Pharmacy Market Size, Growth and Forecast 2032*. *Credence Research Inc.* Available at: https://www.credenceresearch.com/report/uae-retail-pharmacy-market (Accessed: 22 July 2025).

Crudu, V. (2025) *Top Inventory Management Software Trends for Retailers in 2025*. Available at: https://moldstud.com/articles/p-top-inventory-management-software-trends-for-retailers-in-2025 (Accessed: 17 July 2025).

Dagher, M. (2025) *Breaking Down the UAE’s Data Protection Law*. *HNS LEGAL - Law Firm*. Available at: https://hnslegal.com/2025/05/13/breaking-down-uae-data-protection-law/ (Accessed: 10 July 2025).

Dharaniya. *et al.* (2024) ‘Pharmatics Drug Inventory And Supply Chain Tracking System’. *International Research Journal of Modernization in Engineering Technology & Science*, 6(11). Available at: https://www.irjmets.com/uploadedfiles/paper//issue_11_november_2024/63622/final/fin_irjmets1732327285.pdf?

Dubey, M., Vishwakarma, H. and Nisha, P. (2022) ‘Review Article on Pharmaceutical Inventory Models’. *Journal of Drug Delivery and Therapeutics*, 12(5-S), pp. 230–235. DOI: 10.22270/jddt.v12i5-S.5659.

Eckford, C. (2023) *Big Pharma Inventory Management Trends Revealed*. *European Pharmaceutical Review*. Available at: https://www.europeanpharmaceuticalreview.com/news/183076/big-pharma-inventory-management-trends-revealed/ (Accessed: 28 March 2025).

EMA. (2024) ‘Annual Report 2023’. Available at: https://www.ema.europa.eu/en/documents/annual-report/2023-annual-report-european-medicines-agency_en.pdf (Accessed: 19 March 2025).

FDA Drug Shortages. (2023) ‘FDA Drug Shortages’. Available at: https://www.fda.gov/media/179156/download (Accessed: 18 March 2025).

Focus, S. toGN. (2023) *Redefining Convenience: Burjeel Pharmacy Leads the Way to a Patient-Centric Future*. *Gulf News*. Available at: https://gulfnews.com/uae/health/redefining-convenience-burjeel-pharmacy-leads-the-way-to-a-patient-centric-future-1.1700228759082 (Accessed: 8 August 2025).

Freeman-Muhammad, S. *et al.* (2024) ‘Impact of Connected Dispensing Technology with Advanced Analytics in a Multicenter Health System’. *American Journal of Health-System Pharmacy*, 81(23), pp. e760–e769. DOI: 10.1093/ajhp/zxae198.

Gaoual, Y. *et al.* (2025) ‘Mitigating Risks in Hospital Stock Management: A Structured Method for Validating Excel Files’. *Hospital Pharmacy*, p. 00185787251337614. DOI: 10.1177/00185787251337614.

George, S. and Elrashid, S. (2023) 'Inventory Management and Pharmaceutical Supply Chain Performance of Hospital Pharmacies in Bahrain: A Structural Equation Modeling Approach'. *SAGE Open*, 13(1), p. 21582440221149717. DOI: 10.1177/21582440221149717.

Gupta, P. *et al.* (2023) 'Inventory Management for Pharmacy'. *International Journal for Research in Applied Science and Engineering Technology*, 11(5), pp. 852–855. DOI: 10.22214/ijraset.2023.51618.

Hashad, N. *et al.* (2021) 'A Qualitative Study of Pharmacist Perception Regarding the Implementation of Automated Pharmacy Dispensing Systems in the United Arab Emirates' Hospitals'. Available at: https://rgu-repository.worktribe.com/output/1555729 (Accessed: 10 July 2025).

Hayes, A. (2024) *Inventory Management: Definition, How It Works, Methods & Examples*. *Investopedia*. Available at: https://www.investopedia.com/terms/i/inventory-management.asp (Accessed: 7 July 2025).

Hearson, J. (2024) *Stop Stockout Stress: How to Master Inventory Management*. Available at: https://www.oracle.com/europe/scm/inventory-management/what-is-inventory-management/ (Accessed: 4 August 2025).

IBM. (2023) *What Is Inventory Management? | IBM*. Available at: https://www.ibm.com/think/topics/inventory-management (Accessed: 19 July 2025).

Innovent. (2023) *How Healthcare Inventory Management in Dubai Is Reducing Medical Waste*. Available at: https://www.innovent.io/news/how-healthcare-inventory-management-in-dubai-is-reducing-medical-waste (Accessed: 5 August 2025).

Insights10. (2022) *UAE Retail Pharmacy Market Analysis Report 2022 to 2030*. Available at: https://www.insights10.com/report/uae-retail-pharmacy-market-analysis/www.insights10.com/report/uae-retail-pharmacy-market-analysis/ (Accessed: 22 July 2025).

Jadhao, A., Dungu, P. and Sanap, J. (2024) 'A Cost-Benefit Analysis of Real-Time Inventory Tracking Systems for Pharmaceuticals: Balancing Efficiency and Implementation Costs'. Available at: https://www.ijrti.org/papers/IJRTI2412026.pdf (Accessed: 8 July 2025).

Jaju, R. *et al.* (2023) 'Inventory Control Mechanism of the Pharmacy Store of a Recently Established National Institute in Eastern India: A Cross-Sectional, Investigative Analysis'. *Cureus*, 15(11). DOI: 10.7759/cureus.49632.

Jenkins, A. (2025) *Your Guide to Healthcare Inventory Management*. *Oracle NetSuite*. Available at: https://www.netsuite.com/portal/resource/articles/erp/healthcare-inventory-management.shtml (Accessed: 17 July 2025).

Jongh. *et al.* (2021) 'Future-Proofing Pharmaceutical Legislation'. Available at: https://op.europa.eu/en/publication-detail/-/publication/1f8185d5-5325-11ec-91ac-01aa75ed71a1/language-en (Accessed: 18 March 2025).

Kartikasari, M.A. (2024) ‘Design of Medicine Inventory System’. *Journal Logistic Indonesia*, 8(2), pp. 122–131.

Kaushik, V. and Walsh, C.A. (2019) (9) ‘Pragmatism as a Research Paradigm and Its Implications for Social Work Research’. *Social Sciences*, 8(9), p. 255. DOI: 10.3390/socsci8090255.

Leto, C. (2025) *Pharmacy Inventory Management: A Complete Guide*. *HashMicro Philippine Blog*. Available at: https://www.hashmicro.com/ph/blog/pharmacy-inventory-management-system/ (Accessed: 4 March 2025).

MIR. (2024) *Market Insights Research*. *Market Insights Research*. Available at: https://marketinsightsresearch.com/industry-research/uae-pharmacy-retail-market (Accessed: 30 May 2025).

Ogbewele, Mbata, and Nwosu (2024) ‘Optimizing Pharmaceutical Inventory Management: A Global Framework for Efficiency and Cost Reduction’. *International Journal of Management & Entrepreneurship Research*, 6(10), pp. 3357–3371. DOI: 10.51594/ijmer.v6i10.1638.

Ratnala, A.K., Sivathapandi, P. and Muthusubramanian, M. (2022) ‘Cloud-Based Solutions for Enhancing B2B Pharmacy Applications: Accelerating Digital Transformation in Pharmaceutical Supply Chains’. 3. Available at: https://thesciencebrigade.com/jst/article/view/500 (Accessed: 4 August 2025).

Reports, G.M. (2024) *Pharmacy Inventory Management Software Market Research Report 2033*. Available at: https://growthmarketreports.com/report/pharmacy-inventory-management-software-market (Accessed: 4 August 2025).

Saha, E. and Rathore, P. (2024) ‘A Smart Inventory Management System with Medication Demand Dependencies in a Hospital Supply Chain: A Multi-Agent Reinforcement Learning Approach’. *Computers & Industrial Engineering*, 191, p. 110165. DOI: 10.1016/j.cie.2024.110165.

Sajja, G.S. *et al.* (2025) ‘Optimizing Inventory Management through AI-Driven Demand Forecasting for Improved Supply Chain Responsiveness and Accuracy’. *AIP Conference Proceedings*, 3306(1), p. 050003. DOI: 10.1063/5.0275697.

Saunders, M. *et al.* (2019) ‘Understanding Research Philosophy and Approaches to Theory Development’. In *ResearchGate*. Pearson Education, pp. 128–171. Available at: https://www.researchgate.net/publication/330760964 (Accessed: 28 July 2025).

Schueler, S. (2022) *8 Benefits of Implementing Web-Based Inventory Management*. *The Megaventory Blog*. Available at: https://blog.megaventory.com/2022/07/benefits-of-web-based-inventory-management/ (Accessed: 28 July 2025).

Shashi, M. (2023) (11) ‘Sustainable Digitalization in Pharmaceutical Supply Chains Using Theory of Constraints: A Qualitative Study’. *Sustainability*, 15(11), p. 8752. DOI: 10.3390/su15118752.

Shen, J. *et al.* (2024) ‘Management of Drug Supply Chain Information Based on “Artificial Intelligence + Vendor Managed Inventory” in China: Perspective Based on a Case Study’. *Frontiers in Pharmacology*, 15. DOI: 10.3389/fphar.2024.1373642.

Sisgain. (2025) *Top Healthcare Software Solution Trends in UAE*. *healthcaresoftware*. Available at: https://healthcaresoftware.odoo.com/blog/our-blog-1/top-healthcare-software-solution-trends-in-uae-4 (Accessed: 28 July 2025).

TBRC. (2025) *Pharmacy Inventory Management Software Solutions and Cabinets Market Report 2025-2034*. Available at: https://www.thebusinessresearchcompany.com/report/pharmacy-inventory-management-software-solutions-and-cabinets-global-market-report (Accessed: 4 August 2025).

Thapa, A. *et al.* (2025) ‘AI-Based Inventory System’. *International Research Journal of Modernization in Engineering Technology & Science*, 7(1), pp. 868–871.

Tony, C. (2023) *Revolutionising Pharmacy Operations: The Impact of Cloud-Based Inventory Solutions*. *Outershift*. Available at: https://outershift.com.au/cloud-based-pharmacy-inventory-solutions/ (Accessed: 4 August 2025).

Trường, M.X. (2021) *What Is Inventory Management Model? 3 Types of Different Model*. *Magenest - One-Stop Digital Transformation Solution*. Available at: https://magenest.com/en/inventory-management-models/ (Accessed: 4 August 2025).

UAE Data protection laws. (2024) *Data Protection Laws | The Official Portal of the UAE Government*. Available at: https://u.ae/en/about-the-uae/digital-uae/data/data-protection-laws (Accessed: 5 August 2025).

UAE Digital Government Strategy. (2025) *The UAE Digital Government Strategy 2025 | The Official Portal of the UAE Government*. Available at: https://u.ae/en/about-the-uae/strategies-initiatives-and-awards/strategies-plans-and-visions/government-services-and-digital-transformation/uae-national-digital-government-strategy (Accessed: 18 July 2025).

Ugbebor, F., Adeteye, M. and Ugbebor, J. (2024) (1) ‘Automated Inventory Management Systems with IoT Integration to Optimize Stock Levels and Reduce Carrying Costs for SMEs: A Comprehensive Review’. *Journal of Artificial Intelligence General Science (JAIGS) ISSN:3006-4023*, 6(1), pp. 306–340. DOI: 10.60087/jaigs.v6i1.257.

Ujjawal. and Natesan, G. (2023) ‘Cloud Based Inventory Management System’. *International Journal of Advanced Research in Computer and Communication Engineering*, 12(3), pp. 307–309. DOI: 10.17148/IJARCCE.2023.12354.

Vangari, S. (2025) ‘Leveraging AI and Machine Learning for Enhanced Inventory Optimization: A Framework for Efficiency and Demand Forecasting’. *IJRPR*, 6(3), pp. 995–998.

WHO. (2021) *Global Strategy on Digital Health 2020-2025*. 1st ed. Geneva: World Health Organization Available at: https://www.who.int/docs/default-

source/documents/gs4dhdaa2a9f352b0445bafbc79ca799dce4d.pdf (Accessed: 9 March 2025).

APPENDICES

APPENDIX A – SURVEY QUESTIONNAIRE

https://forms.gle/unthBG5AaUyEUBtKA

Dear Participant,
My name is Susanna Kurian, and I am currently pursuing MSc in Digital Transformation at Griffith College, Dublin, Ireland. This survey is part of my research project titled "The Impact of Cloud-Based Inventory Management Systems on Stock Optimisation and Real-Time Tracking Across Multiple Pharmacy Locations in UAE Chain Pharmacies."
The aim of this research is to collect information about experience and opinion of pharmacy managers and pharmacists with respect to adoption and impact of cloud-based inventory management systems. Your participation is voluntary. All responses will remain confidential and will be used solely for academic research purposes. You are free to withdraw from the survey at any time without any consequences. This study will not collect or share any personally identifiable data.

Your involvement as a pharmacist or pharmacy manager is much appreciated and will considerably contribute to my research. The survey will take about 10-15 minutes to complete.

For further information please contact me at susanna.kurian@student.griffith.ie

Do you consent to participate in this survey?

☐ Yes, I consent to participate.
☐ No, I do not consent to participate.

(If you select "No," please do not proceed with the survey.)

Section 1: Screening

1. Have you used a cloud-based inventory management system at your present pharmacy for at least 6 months?

☐Yes
☐No

(If "No," please do not proceed with the survey.)

Section 2: Background information about the participants

2. What is your current position?
   ☐ Pharmacist
   ☐ Pharmacy Manager
3. How long have you been employed at retail pharmacy?
   ☐ 6 months – 1 year
   ☐ 1–3 years
   ☐ 4–7 years
   ☐ More than 7 years
4. How many pharmacies does your company operate in the UAE?
   ☐ 1–5

☐ 6–15
☐ 16–30
☐ More than 30

Section 3: Inventory management methods before the introduction of the cloud technologies

5. What type of inventory management system did your pharmacy utilize before switching to a cloud-based solution?
   ☐ Manual (paper-based)
   ☐ Spreadsheets/ Excel
   ☐ Local software (non-cloud)
   ☐ Others (please specify): _____

6. Please rate the following features of your previous inventory system:

(1 = very poor, 2 = poor, 3 = good, 4 = very good, 5 = excellent)

Feature	**1**	**2**	**3**	**4**	**5**
Ease of use					
Accurate stock records					
Real-time inventory tracking					
Managing inventory across several branches					
Preventing stockouts/overstocking					

7. What were the main difficulties you experienced with the previous system? (Select all that apply)
   ☐ Delays in stock updates
   ☐ Incorrect inventory records
   ☐ Difficulties in managing stocks of multiple branches
   ☐ Regular stockouts/overstocking
   ☐ Lack of proper reporting/analytics
   ☐ Other (please specify): _____

Section 4: Features of Cloud-Based Inventory Management

8. Please rate the importance of the following characteristics in your currently operational cloud-based system:(1 = Not Important, 2=Slightly Important, 3 = Moderately Important, 4 = Important, 5 = Very Important)

Feature	**1**	**2**	**3**	**4**	**5**
Track inventories in real time					
Automatic stock alert					

Centralized data access					
Integration with POS					
Inventory data analysis and reporting					
Remote system access					
Synchronisation across different branches					

9. How has the cloud-based system influenced your inventory management?

Area	**Greatly Improved**	**Improved**	**No change**	**Worsened**
Availability of stock				
Accuracy of inventory				
Time spent for managing stocks				
Stock visibility across multiple branches				

10. How satisfied are you with the real-time tracking features of the current system?
    - ☐ Very dissatisfied
    - ☐ Dissatisfied
    - ☐ Neutral
    - ☐ Satisfied
    - ☐ Very satisfied

Section 5: Benefits and Challenges of cloud-based inventory management system

11. What benefits have you noticed while using the cloud-based system? (Select all the options that apply)
    - ☐ Stock accuracy improved
    - ☐ Reduced stockouts
    - ☐ Reduced overstocking
    - ☐ Easier management of stocks across multiple branches
    - ☐ Improved reporting and analytics
    - ☐ Greater workflow efficiency
    - ☐ Other (please specify): _____
12. What challenges have you observed with the cloud-based system? (Select all the options that apply)
    - ☐ Data security issues
    - ☐ Internet connectivity concerns
    - ☐ Staff training requirements
    - ☐ Poor integration with other systems in the pharmacy
    - ☐ High implementation cost

☐ Other (please specify): _____

Section 6: Impact on Stockouts and Overstocking

13. How frequently have you experienced stockouts since using the cloud-based system?
    ☐ Much less often
    ☐ Less often
    ☐ About the same
    ☐ More often
    ☐ Much more often
14. How frequently have you experienced overstocking since implementing the cloud-based system?
    ☐ Much less often
    ☐ Less often
    ☐ About the same
    ☐ More often
    ☐ Much more often
15. How efficient is the system in alerting to low or overstocked circumstances?
    ☐ Not effective
    ☐ Slightly effective
    ☐ Moderately effective
    ☐ Very effective
    ☐ Extremely effective

Section 7: Impact on Workflow and Staff Experience

16. How simple was it for you to adjust to the new cloud system?
    ☐ Very difficult
    ☐ Difficult
    ☐ Neutral
    ☐ Easy
    ☐ Very easy
17. How has the cloud-based system affected your daily work?
    ☐ Significantly worsened
    ☐ Somewhat worsened

☐ No impact

☐ Somewhat improved
☐ Significantly improved

18. How do you think the cloud-based technology has affected your customer service?
    ☐ Greatly worsened customer service
    ☐ Somewhat worsened customer service
    ☐ No impact on customer service
    ☐ Somewhat improved customer service
    ☐ Greatly improved customer service

19. How satisfied are you with cloud-based inventory management system in your pharmacy overall?

    ☐ Very dissatisfied

    ☐ Dissatisfied

    ☐ Neutral

    ☐ Satisfied

    ☐ Very satisfied

20. What do you think is the biggest advantage or limitation of implementing cloud-based inventory management in your organisation?

    _____

21. In your opinion, what improvements should be made to current inventory management system?

    _____

22. Please share any additional comments regarding the use of cloud-based inventory management in your pharmacy:

    _____

APPENDIX B – ETHICS FORM

Innopharma education

GRIFFITH COLLEGE

Ethics Application & Declaration Form- SURVEY

DISSERTATION TITLE: The impact of cloud-based inventory management systems on stock optimisation and real-time tracking across multiple pharmacy locations in UAE chain pharmacies.

RESEARCHER'S NAME: Susanna Kurian

PROGRAMME OF STUDY: MSc Digital Transformation

SUPERVISOR'S NAME: Eucharia Esemuede

DECLARATION:

The information in this application form is accurate to the best of my knowledge. I undertake to abide by the principles outlined by Innopharma/Griffith College ethics policy in my research dissertation. I confirm that I have completed a full ethics assessment for my research dissertation as per the college guidelines. I will not begin my primary research until such approval from my supervisor and/or ethics Committee has been obtained.

I pledge to carry out my research according to the Innopharma/Griffith College academic integrity standards. Any results presented in my dissertation will be from my own, original research, I will reference and/or acknowledge any material or sources used in its preparation and I will not plagiarise the work of anyone else.

For Student:

STUDENT SIGNATURE: 

DATE: 30/06/2025

The research contained within this research dissertation proposal has been approved.

For Supervisor:

Ethics Committee Approval Required: Yes ☐ No ☑

SUPERVISOR SIGNATURE: 

DATE: 03/07/2025

For Ethics Committee (if required):

Ethics Committee Approval Given: Yes ☐ No ☐

ETHICS COMMITTEE MEMBER SIGNATURE:

DATE:

SECTION 1: DESCRIPTION OF RESEARCH STUDY

1.1 Purpose and objectives of research

Purpose: The purpose of this study is to evaluate the impact of cloud-based inventory management systems on stock optimisation and real-time tracking across multiple pharmacy locations in UAE retail pharmacies. The effect of cloud-based inventory systems on group pharmacy efficiency is examined in this study, with a focus on stock control and real time tracking. Pharmacy inventory management has been revolutionised using cloud-based inventory management, an advanced technology that offers multiple advantages, including simplifying complex processes, stock optimisation and real time tracking. The findings of current literature shows that cloud-based inventory management systems are becoming a growing trend in the pharmaceutical industry, but there is a significant knowledge gap due to the lack of focused insights on features, advantages, limitations as well as impact on the daily work of pharmacy employees with the use of cloud-based inventory management in retail group pharmacies. Therefore, this research will gather information from pharmacists and pharmacy managers to learn more about their experiences, problems, and perceived benefits of using such technology in their day-to-day operations.

Objectives:

- To examine how retail chain pharmacies managed their inventory before implementing cloud-based solutions.
- To assess the key features of cloud-based inventory management systems that help with real-time tracking and stock optimisation.
- To evaluate the benefits and challenges of implementing cloud-based inventory management in real time tracking and stock optimisation across multiple pharmacy locations in UAE.
- To investigate the potential of cloud-based inventory management in reducing stockouts and overstocking in group pharmacies.
- To assess the experience of pharmacy staff working in group pharmacies regarding use, effectiveness, and impact of cloud-based inventory management in their daily workflow.

1.2 Research methodology:

This study will be centred around a pragmatic philosophy, prioritising practical results and combining quantitative and qualitative data to effectively address the research objectives. Through a mixed method approach this study will collect quantitative and quantitative findings about the use and effects of cloud-based inventory management systems in chain pharmacies using online survey. The closed-ended questions facilitate statistical analysis of trends and outcomes by collecting numerical data on system usage and its impacts. The open-ended questions offer participants the opportunity to share their own opinions and observations, providing deeper insights into practical challenges and benefits of cloud-based inventory solutions. This combined method offers a more comprehensive understanding of the research objectives. The survey link will be shared through emails, professional pharmacy networks, and social media groups that are significant to pharmacists working within chain pharmacies in the UAE. The participants include English speaking Licensed pharmacists or pharmacy managers working in chain pharmacies in the UAE with at least six months of practical involvement with cloud-based inventory management systems.

A sample of 358 participants will be surveyed using structured online questionnaires about the use and effects of cloud-based inventory management systems in chain pharmacies. The responses collected are related to aspects like stock optimisation, the

effectiveness of real-time tracking, user satisfaction, operational efficiency and are analysed using descriptive statistics to reveal trends, patterns, and frequency distributions linked to inventory management techniques, real-time tracking, and stock optimisation with statistical significance assessed through tests like chi-square test and t-test. The qualitative insights from the online survey will be reviewed using thematic analysis to identify and understand relevant themes and insights that relate to the study objectives. The study findings will be presented in the final report with charts, tables, graphs, and thematic interpretations along with appropriate explanation using data visualisation techniques.

SECTION 2: POSSIBLE ETHICAL ISSUES

Answer 'yes' or 'no' to the following questions.

SUBJECT MATTER

Does the research proposal involve:

Research into specific company activities that would be deemed sensitive or confidential
No

Research into politically and/or racially/ethnically and/or commercially sensitive areas
No

Sensitive, personal, professional or corporate issues
No

RESEARCH PROCEDURES

Does the research proposal involve:

Research that might damage the reputation of companies or participants	No
Research that may negatively affect the reputation of Griffith College/Innopharma	No
Use of personal records without consent	No
Use of company data without consent	No
The offer of any inducements to participate	No
Audio or visual recording without consent	No
Using a language other than English	No

PARTICIPANTS

Does the research proposal involve:

People who are not competent and/or fluent in English	No
Does your research group include any of the following vulnerable groups	No

If you have answered NO to ALL questions, please go straight to Section 4.

If you have answered YES to ANY question in SECTION 2, you must fill in SECTION 3.

SECTION 3: STEPS TAKEN TO AVOID ETHICAL ISSUES

3.1. If your ethics relates to ***Subject Matter***, outline your action plan to work around any sensitive issues.
3.2. If your ethics relates to ***Research Procedures***, outline your action plan to deal with possible ethical issues in your research procedures.
3.3. If your ethics relates to ***Participants***, outline how you will protect vulnerable persons or those that do not have English as their first language.

SECTION 4: ABOUT YOUR PARTICIPANTS

4.1. Outline your participant profile and why you have chosen them for this study.
Participants in this research will be registered pharmacists' and pharmacy managers working in retail chain pharmacies in the United Arab Emirates (UAE).
These participants have been chosen since they are primarily end-users of cloud-based stock management solutions in their organisations and directly encounter inventory management processes such as real-time monitoring and stock optimisation. Their professional roles provide them with direct experience and familiarity with the operational issues and advantages of such systems. The opinion and feedback of pharmacists and pharmacy managers are very important to this research as their response provides direct and practical data on the real use, benefits, and problems of cloud-based inventory management systems in the retail pharmacy setting, and their perspectives will enhance the significance of the research findings.

4.2 How do you plan to gain access to/contact/approach your participant(s).
Based on my professional experience in the UAE pharmacy sector, I would first contact my colleagues who work at retail chain pharmacies and encourage them to participate in the study. I will also ask them to engage their colleagues and pharmacist networks to join in the survey. Online survey will also be distributed via pharmacist focused social media groups and professional networks such as LinkedIn to reach a wider group of registered pharmacists and pharmacy managers. Purposive and snowball sampling will be utilized to choose participants, ensuring that only individuals who are easily accessible and willing are included in the study. This approach will ensure that the data gathered is both relevant and

useful for evaluating the impact of cloud-based inventory management on real-time tracking and stock optimisation in UAE retail chain pharmacies.

SECTION 5: INFORMATION, CONSENT AND CONFIDENTIALITY

5.1 Participant Information Letter (PIL) for participants

Please confirm below that your information letter covers:

Description of the research topic and method	N/A
Details of what participation will involve	N/A
Rights to anonymity	N/A
Confidentiality	N/A
Rights to withdraw from the research	N/A
The contact details of the researcher and supervisor (if necessary)	N/A

5.2 Informed Consent Form (ICF) for participants

Please indicate below if your research requires a signed consent form by selecting the relevant option only:
No: my research involves online survey and does not require signed consent . Consent will be included at beginning of online survey as follows:
Do you consent to participate in this survey?

☐ Yes, I consent to participate.

☐ No, I do not consent to participate.

SECTION 6: STORAGE OF DATA

6.1. How will you store the research data and for how long? How will you manage data protection issues?

All data collected for the study will be securely stored in digital format on a password protected laptop to ensure security. The data will be held on an encrypted, password-protected device, with the researcher as the only one having access to it. To avoid data loss and ensure data integrity throughout the study, a backup copy of all research data will be securely stored on a cloud storage platform, like OneDrive. Once the research is complete, anonymized survey responses will be submitted to the college via Moodle in accordance with formal research submission guidelines. To ensure participant anonymity, personal identifiers will be deleted at data collection stage in accordance with the General Data

privacy Regulation (GDPR) and Ireland's national health data privacy legislation. Data collected will be maintained for not more than two years after the qualification is awarded. Following this period, all data will be permanently deleted from storage. If college policy requires longer data retention, data will be preserved in compliance with data privacy standards.

SECTION 7: NON-DISCLOSURE AGREEMENT & STUDENT CONSENT

7.1 Non-Disclosure Agreement (NDA)

Will the final dissertation contain any information pertaining to any source what would warrant the use of a Non-Disclosure Agreement (NDA) e.g. industry-based research?

No

7.2 Student consent

If a Non-Disclosure Agreement (NDA) is not required, does the student consent to allow their completed dissertation to be held/published by Innopharma/Griffith College?

Yes

SECTION 8: RECORDING AND RETENTION OF DISSERTATION VIVA

8.1 Viva Recording

The Dissertation viva will be recorded. This recording may be used to facilitate assessment by Innopharma staff, a third reader if necessary and/or if requested by the external examiner for the Programme. The recording will be held in line with current GDPR guidelines and will not be made publicly available.

SECTION 9: DOCUMENT CHECKLIST

NOTE: Applicants must attach the following documents in electronic format to the appendix.

Which documents are added to the appendix? Please tick N/A if not applicable:

9.1 Participant Information Letter (PIL) for participant N/A

9.2 Informed Consent Form (ICF) for participant N/A

9.3 Questions/survey for interviewees/focus groups etc *(can be in draft form)* Yes

9.4 Any other documents e.g. Non-Disclosure Agreement N/A

I confirm that this application is complete, and all required documents are included in the appendix.

For Student:

STUDENT SIGNATURE: 

DATE: 30/06/2025

APPENDIX C – EXAMPLE CBIMS DASHBOARD

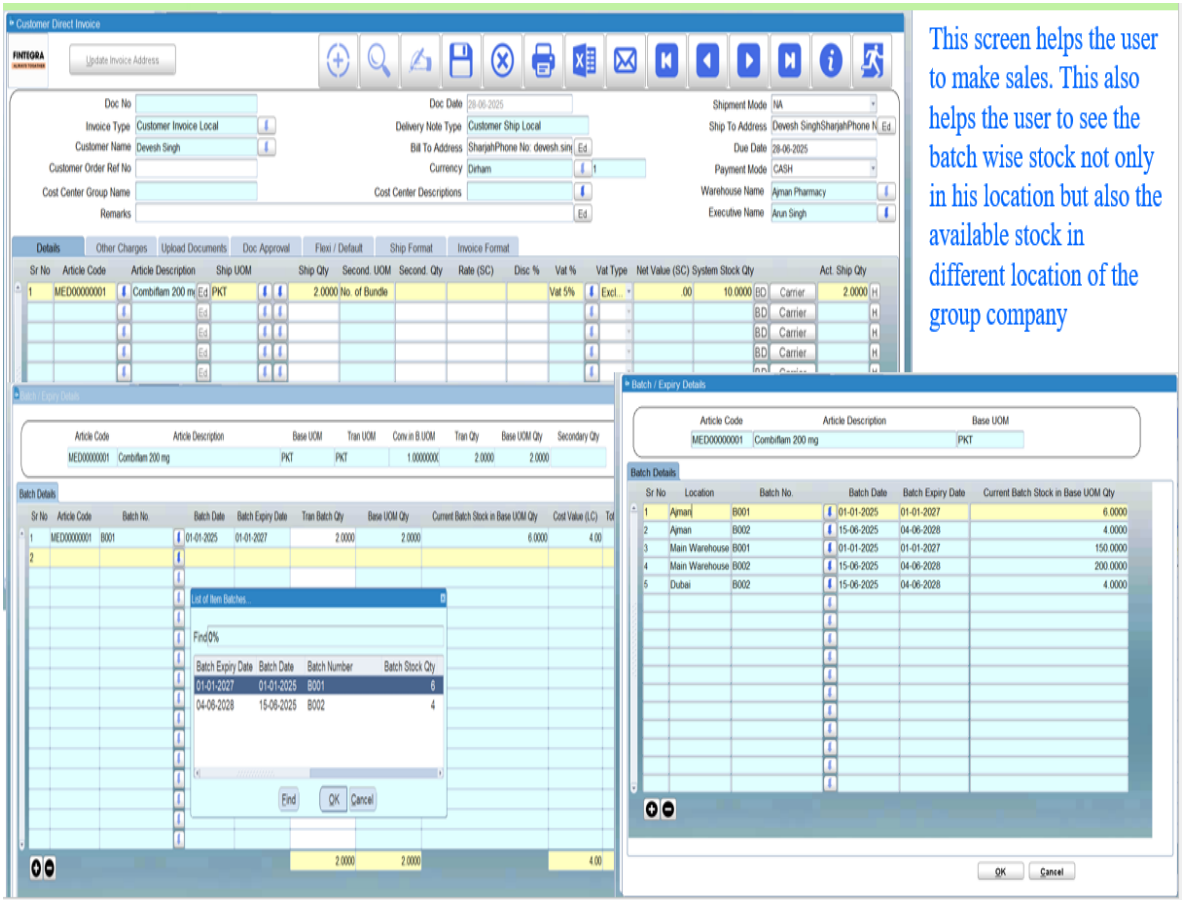

Figure 24: Example of CBIMS interface used for stock optimisation and real-time tracking (provided by system vendor)