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Optimising Warehouse Layout and Internal Material Flows to Improve Logistics Performance in a Local Health Unit

Maria Ramos da Silva Fonseca

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FEP FACULDADE DE **ECONOMIA E GESTÃO**

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Internship Report

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Abstract

Hospital logistics is increasingly recognized as a critical component of healthcare performance, particularly within integrated care systems that require coordination across multiple levels of service delivery. Although existing literature highlights the strategic importance of hospital logistics and the role of digital systems in improving efficiency, fewer studies have focused on the combined analysis of warehouse layout, internal material flows, and picking route organisation within Local Health Units. Moreover, there is limited empirical evidence addressing how physical logistics configurations can support recently implemented digital logistics solutions in an integrated healthcare context. Therefore, this internship report aims to analyse the logistics operations of the Local Health Unit of Matosinhos, identify operational inefficiencies, implement feasible improvement measures, and evaluate their impact on warehouse performance. A case study methodology was adopted, combining direct observation of logistics processes, analysis of operational data and key performance indicators, process mapping, and the implementation and evaluation of initiatives such as layout reorganisation, picking route optimization, and visual management practices. The results showed improved warehouse organisation, reduced travel distances during picking operations, greater process standardisation, and more efficient internal material flows, contributing to higher operational efficiency and supporting the performance of the recently implemented digital logistics system. Overall, the study indicates how relatively simple layout redesign, route optimization, and visual management improvements can support recently implemented digital logistics systems and improve warehouse efficiency in an integrated healthcare environment.

Keywords: Hospital Logistics; Integrated Healthcare; Inventory Management; Picking Routes; Warehouse Layout.

JEL Codes: I18, L23, M11.

Resumo

A logística hospitalar é cada vez mais reconhecida como uma componente crítica do desempenho das organizações de saúde, particularmente em sistemas de cuidados integrados que exigem coordenação entre múltiplos níveis de prestação de serviços. Embora a literatura existente destaque a importância estratégica da logística hospitalar e o papel dos sistemas digitais na melhoria da eficiência, existem menos estudos focados na análise integrada do layout dos armazéns, dos fluxos internos de materiais e da organização das rotas de picking no contexto das Unidades Locais de Saúde. Além disso, a evidência empírica sobre a forma como as configurações físicas da logística podem apoiar soluções logísticas digitais recentemente implementadas em contextos de cuidados de saúde integrados é ainda limitada. Assim, o presente relatório de estágio tem como objetivo analisar as operações logísticas da Unidade Local de Saúde de Matosinhos, identificar ineficiências operacionais, implementar medidas de melhoria exequíveis e avaliar o seu impacto no desempenho do armazém. Para tal, foi adotada uma metodologia de estudo de caso, que combinou a observação direta dos processos logísticos, a análise de dados operacionais e de indicadores-chave de desempenho, a análise de processos e a implementação e avaliação de iniciativas como a reorganização do layout, a otimização das rotas de picking e a aplicação de práticas de gestão visual.

Os resultados evidenciaram uma melhoria da organização do armazém, a redução das distâncias percorridas durante as operações de picking, uma maior padronização dos processos e fluxos internos de materiais mais eficientes, contribuindo para um aumento da eficiência operacional e para o reforço do desempenho do sistema logístico digital recentemente implementado. De um modo geral, o estudo demonstra que intervenções relativamente simples, incluindo a reorganização do layout, a otimização das rotas e a gestão visual, podem complementar os sistemas logísticos digitais e melhorar o desempenho do armazém num contexto integrado de cuidados de saúde.

Palavras-chave: Cuidados de Saúde Integrados; Gestão de Stocks; Hospital Logistics; Picking Routes; Warehouse Layout.

Códigos JEL: I18, L23, M11.

Contents

Acknowledgement ii

Abstract iii

Resumo iv

Contents v

List of Tables x

List of Figures xi

Abbreviations xii

1. Introduction 1

1.1. Context and Motivation 1

1.2. Internship Context and Organisational Setting 1

1.3. Objectives of the Internship 2

1.4. Structure of the Work 2

2. Theoretical and Organisational Context 4

2.1. Local Health Units 4

2.1.1 Concept and Definition 4

2.1.2 Evolution of Local Health Units in the International Context 4

2.1.3 Evolution of Local Health Units in Portugal 5

2.1.4 Local Health Units and Technological Advances 6

2.2. Local Health Unit of Matosinhos 6

2.2.1 Organisational Overview 6

2.2.2 Hospital Logistics Initiatives at the Local Health Unit of Matosinhos . 7

2.3. Hospital Logistics 8

2.3.1 Strategic Importance of Hospital Logistics 8

2.3.2 Current Problems and Challenges 9

2.3.3 Proposed Solutions and Evidence of Impact 10

2.3.4 Research Gaps and Study Justification....10
3. Methodology....12
3.1. Methodological Foundations....12
3.1.1 Methodological Approaches in Healthcare Operations and Logistics Studies 12
3.1.2 Layout Optimization and Internal Flow Analysis in Healthcare....13
3.1.3 Lean and Visual Management Approaches in Hospital Logistics....13
3.1.4 Inventory Control and Traceability Systems....15
3.1.5 Data Collection and Analysis Methods Used in Previous Studies....16
3.1.6 Logistics Performance Measurement....17
3.2. Research Methodology....18
3.2.1 Research Design....18
3.2.2 Research Framework....19
3.2.3 Data Collection....21
3.2.4 Data Processing Tools....22
3.2.5 Data Analysis Methods....22
3.2.6 Performance Indicators....24
4. Logistics and Warehouse Operations at ULSM....25
4.1. Characterization of the Logistics Service....25
4.1.1 Warehouse Organisation and Layout....27
4.1.2 Inventory Management System in the Warehouse and Supermarkets 32
4.1.2.1 Kanban System in the Warehouse....33
4.1.2.2 Supermarket System and Two-Bin Method....34
4.1.3 Picking Routes....36
4.1.3.1 Initial Route....36
4.1.3.2 Optimization of the Specific and General Zones....38
4.1.3.3 Initial Operation Measurement....42

4.1.3.4 Assessment of operators' needs and suggestions 44
4.1.3.5 Proposed changes to the picking route 44
4.1.3.6 Operations measurement after route modification 46
4.1.3.7 Summary of the Picking Route Optimization 49
4.1.4 Continuous Improvement and 5S Assessment 50
4.1.4.1 Visual Analysis of the Warehouse 51
4.1.4.2 Implementation of Improvements in the Warehouse 52
4.1.4.3 Development of a 5S Audit 55
4.1.4.4 Pilot Application for the 5S Audit 56
4.1.5 Internal Distribution Routes 57
4.1.5.1 Characterization and Operational Structure of the Internal Distribution System 58
4.1.5.2 Operational Variability of Distribution Routes 59
4.1.5.3 Organisation and Sequencing Distribution Stops 60
4.1.5.4 Proposed Sequencing of Distribution Routes 61
4.1.5.5 Summary of the Internal Distribution Analysis 62
5. Conclusion 64
6. Appendices 66
Appendices 1 – Optimization of the Specific and General Zones 66
Appendices 2 – Analysis of Picking Routes in the Initial Warehouse Layout: Sample 1 67
Appendices 3 - Analysis of Picking Routes in the Initial Warehouse Layout: Sample 2 67
Appendices 4 - Analysis of Picking Routes in the Initial Warehouse Layout: Sample 3 68
Appendices 5 - Analysis of Picking Routes in the Initial Warehouse Layout: Sample 4 68

Appendices 6 - Proposed reorganisation of the picking route in the warehouse starting in the General Zone....69

Appendices 7 - Proposed reorganisation of the picking route in the warehouse starting in the Specific Zone....69

Appendices 8 - Proposed reorganisation of the picking route in the warehouse starting in the Pallets Zone....70

Appendices 9 - Analysis of Picking Routes Following Route Sequence Reorganisation: Sample 1....70

Appendices 10 - Analysis of Picking Routes Following Route Sequence Reorganisation: Sample 2....71

Appendices 11 - Analysis of Picking Routes Following Route Sequence Reorganisation: Sample 3....71

Appendices 12 - Analysis of Picking Routes Following Route Sequence Reorganisation: Sample 4....72

Appendices 13 - Analysed Picking Routes after Updating the Picking Route: Sample A....72

Appendices 14 - Analysed Picking Routes after Updating the Picking Route: Sample B....73

Appendices 15 - Analysed Picking Routes after Updating the Picking Route: Sample C....73

Appendices 16 - Analysed Picking Routes after Updating the Picking Route: Sample D....74

Appendices 17 - Example of Identification in the Operating Block Zone and Item Location Map....74

Appendices 18 - Storage of Materials at Elevated Heights, Hindering Access, and Identification....75

Appendices 19 – Example of Identification Labels Positioned the Operator's Direct Field of Vision....75

Appendices 20 - Implementation of Suspended Item Identification, Improving Information Accessibility and Code Reading during the Picking Process....76

.....76

Appendices 21 – Visual Information on the 5S Methodology 76

Appendices 22 – 5S Audit Questionnaire.....77

Appendices 23 – Pilot Audits.....85

Appendices 24 – Proposed Sequence for Internal Distribution.....89

7. References 93

ANNEXES.....97

Annex 1 – XYZ Classification of 25 Items Located in the Specific Zone.....97

Annex 2 - XYZ Classification of 15 Items Located in the General Zone 98

List of Tables

Table 1 - Operational performance indicators used to evaluate the proposed improvement initiatives. 24

Table 2 - Intervention of the LS in the distinct stages of the warehouse logistics process 26

Table 3 - Number of Stockable Items per Warehouse 28

Table 4 - XYZ classification of the items analysed in the Specific and General zones 40

Table 5 - Performance indicators of the picking routes analysed in the initial state of the warehouse 43

Table 6 - Comparison of picking route performance indicators between the initial and updated routes 46

Table 7 - Performance Indicators of the Analysed Picking Routes after Updating the Picking Route 48

Table 8 - Results of the pilot application of the 5S Audit 57

List of Figures

Figure 1 - Research framework adopted during the internship.....20
Figure 2 - Organisational Structure of the Logistics Department 27
Figure 3 - Warehouse Layout 29
Figure 4 - Location Tree Associated with the Clinical Warehouse 29
Figure 5 - Organisation of a Rack in the Operating Block Zone within the Logistics Management System 30
Figure 6 - Logistics Movements Associated with Warehouse Operations.....32
Figure 7 - Warehouse Processes 32
Figure 8 - Kanban card of a specific item.....34
Figure 9 - Example of a Supermarket Used in ULSM Hospital Departments.....34
Figure 10 - Operation of the Two-Bin System Used in Hospital Supermarkets 35
Figure 11 - Initial Picking Sequence.....37
Figure 12 - Dashboard used to analyse warehouse picking operations, including indicators of consumption, picking lines, and distribution by storage zones 38
Figure 13 - Analysis of picking operations by storage zone and specific warehouse location.....39
Figure 14 - Warehouse layout highlighting the zones analysed during the space optimization intervention 41
Figure 15 - Proposed reorganisation of the picking route in the warehouse, highlighting the suggested sequence for item collection 45
Figure 16 - Comparison of the main performance indicators: (a) Distance travelled, (b) Average distance per item and (c) Efficiency.....47
Figure 17 - Some Improvements in the Identification of Equipment Supporting Operations.....53
Figure 18 - Reinforcement of Floor Markings and Area Delimitation.....54

Abbreviations

LHU - Local Health Unit

ULSM - Local Health Unit of Matosinhos

LS - Logistics Service

TPS - Toyota Production System

RFID - Radio Frequency Identification

PDA - Personal Digital Assistant

PD – Requests

ASR - Automatic Stock Replenishment

MC - Material Consumption

ROP – Reorder Point

OQ – Order Quantity

1. Introduction

1.1. Context and Motivation

Healthcare systems have become increasingly complex over recent decades due to demographic changes, increasing demand for healthcare services, and rising expectations regarding quality, safety, and efficiency (Beaulieu et al., 2020; Goiana-da-Silva, 2024). In this context, healthcare organisations are under growing pressure to optimize internal processes and ensure the efficient use of resources.

Hospital logistics plays a significant role in addressing these challenges, as the timely availability of materials and medicines directly affects clinical performance and patient safety (Ageron et al., 2018). Hospital logistics encompasses the planning, management, and control of material, information, and resource flows within healthcare organisations, including procurement, storage, inventory management, and internal distribution (Ageron et al., 2018). Within these processes, warehouse layout and internal material flows are critical determinants of logistics performance. Layout organisation refers to the physical arrangement of storage and picking areas, as well as circulation paths, while internal flows describe the movement of materials and operators within the warehouse (Costa et al., 2015). Inefficient layouts and poorly organized flows often result in longer processing times, higher operational costs, and increased error rates, negatively affecting service quality and operational efficiency.

These issues are particularly relevant in integrated healthcare organisations, such as Local Health Units (LHUs), where centralized logistics structures support multiple healthcare services. Previous studies indicate that fragmented logistics processes, inadequate warehouse organisation, and inefficient internal flows contribute to stock inaccuracies, service disruptions, and reduced operational efficiency (Karimah et al., 2022; Fallahnezhad et al., 2024). Despite the existing literature on hospital logistics, holistic analyses that jointly address warehouse layout, internal material flows, and operational performance within integrated healthcare systems remain limited (Castro et al., 2020), reinforcing the relevance of the present study.

1.2. Internship Context and Organisational Setting

The present report is developed in the context of a curricular internship conducted at the Local Health Unit of Matosinhos (ULSM), within the field of hospital logistics. This LHU operates under an integrated healthcare model, where centralized Logistics Services

(LSs) support multiple clinical and operational units. ULSM provides a particularly relevant setting because it recently implemented an integrated logistics management system, creating an opportunity to evaluate how physical warehouse organisation can support digital logistics transformation.

The internship represents a professional learning experience focused on the analysis and improvement of logistics performance within the organisation. It addresses concrete operational problems identified in warehouse organisation and internal material flows, which have direct implications for stock management accuracy, service efficiency, and internal coordination. The internship context provides a real-world environment for applying logistics and operations management concepts, while contributing to organisational improvement.

1.3. Objectives of the Internship

The main objective of this curricular internship is to analyse and improve the logistics performance of LHU through the optimization of warehouse layout and internal material flows. This objective aims to address operational inefficiencies, stock management errors, and fragmentation of logistics processes identified within the host organisation.

More specifically, the internship aims to:

- Analyse warehouse operations and internal logistics processes.
- Evaluate the existing warehouse layout, internal material flows, and picking routes to identify operational inefficiencies.
- Develop and implement improvement initiatives related to warehouse layout, picking routes, visual management, and internal distribution processes, where feasible.
- Assess the operational performance of the warehouse using relevant logistics performance indicators.
- Evaluate the operational impact of the proposed improvement measures.

1.4. Structure of the Work

This report is structured into five chapters, following a logical progression from the contextualization of the study to the analysis of the case under investigation and the presentation of its main findings. The first chapter introduces the study, presenting its background and motivation, defining the main and specific objectives, and establishing the scope of the work.

The second chapter establishes the theoretical and organisational foundations of the study, addressing the LHU model and the context of the ULSM, as well as the relevant literature on hospital logistics, warehouse management, internal material flows, and logistics optimization. The third chapter then presents the methodological approach adopted, including the research design, data collection and analysis procedures, and the performance indicators used to assess logistics operations and evaluate the proposed improvement initiatives.

The fourth chapter constitutes the empirical core of the report, presenting the characterization and analysis of logistics and warehouse operations at ULSM, together with the improvement initiatives developed in relation to warehouse organisation, picking routes, continuous improvement and 5S practices, and internal distribution. Finally, the fifth chapter synthesizes the main findings of the study, assesses the achievement of the established objectives, discusses the principal limitations, and identifies opportunities for future improvement and research.

2. Theoretical and Organisational Context

This chapter presents the theoretical and organisational context that underpins the present study. It begins by introducing the concept of Local Health Units and the organisational context of the Local Health Unit of Matosinhos (ULSM). It then reviews the literature on hospital logistics, focusing on warehouse management, internal material flows, and logistics optimization strategies. Finally, the chapter identifies the research gaps that justify the objectives and scope of this study.

2.1. Local Health Units

This chapter provides a conceptual and contextual overview of LHUs as integrated healthcare organisations. It introduces the LHUs model, examines its evolution in the international and national contexts, and discusses the role of technological advances in supporting integrated care systems. This overview establishes the theoretical foundation for the subsequent analysis of a specific LHU.

2.1.1 Concept and Definition

LHUs are organisational models designed to promote the vertical integration of healthcare services, typically combining primary care, hospital care, and, in some cases, continuing care under a single management structure. The core objective of this model is to improve coordination across distinct levels of care, enhance continuity of services, and optimize the use of healthcare resources (Santana, 2014).

Integrated care models such as LHUs aim to overcome the traditional fragmentation of healthcare systems, where services are often organized at levels with limited communication and coordination. By aligning governance, planning, and operational processes, LHUs seek to support patient-centred care pathways and improve overall system efficiency (Goiana-da-Silva, 2024). As such, the LHUs model reflects broader healthcare policy trends focused on integration, accountability, and value-based care.

2.1.2 Evolution of Local Health Units in the International Context

Internationally, healthcare systems have increasingly adopted integrated care models as a response to rising costs, demographic changes, and the growing prevalence of chronic diseases. While the terminology and governance structures vary across countries, many

systems share common principles with the LHUs model, including coordination across care levels, shared accountability, and integrated planning (Gray, 2021).

Models such as Integrated Care Systems and Accountable Care Organisations illustrate this global shift toward integration and system-level thinking in healthcare delivery. These approaches emphasize collaboration between providers and the use of shared information systems to improve continuity and efficiency of care (Ebo, 2025). The evolution of LHUs should therefore be understood within this broader international movement toward integrated and coordinated healthcare systems, rather than as an isolated national development.

2.1.3 Evolution of Local Health Units in Portugal

In Portugal, the development of LHUs represents a strategic response to longstanding challenges related to fragmentation between primary and hospital care. Since their initial introduction, LHUs have been gradually expanded and refined as part of broader health system reforms aimed at improving coordination, efficiency, and equity in access to care (Santana, 2014).

Empirical evidence has been used to assess the impact of the LHUs model in the Portuguese context. A national study examining hospitalized patient readmissions among patients with chronic conditions found that the integration of primary and hospital care within LHUs was associated with a reduced risk of unplanned hospital readmissions in some cases, suggesting improvements in care coordination and continuity (Brito et al., 2020). These findings support the rationale underlying the implementation and expansion of the LHUs model in Portugal.

More recent policy developments have reinforced the role of LHUs as key organisational structures within the Portuguese National Health Service. These reforms reflect an increasing emphasis on integration, accountability, and population-based planning, aligning Portugal with international trends in healthcare system organisation (Goiana-da-Silva, 2024). As a result, LHUs have become central instruments for implementing integrated care policies at the regional and local levels.

Recent analyses of healthcare reforms in Portugal highlight the significant role of primary care transformation in strengthening integrated care models. The Portuguese primary care reform, developed over the last two decades, has emphasized organisational innovation, accountability, and coordination between care levels, creating favourable

conditions for the consolidation and expansion of LHUs within the National Health Service (Pisco & Ramos, 2025). These reforms have reinforced the strategic importance of LHUs as instruments for improving continuity of care and system-level performance in the Portuguese healthcare context.

2.1.4 Local Health Units and Technological Advances

Technological innovation plays a critical role in supporting integrated healthcare models such as LHUs. Digital health solutions, including electronic health records, integrated information systems and data-sharing platforms, are widely recognized as key enablers of coordination across care settings (Gray, 2021).

However, the literature emphasizes that technological advances alone are insufficient to achieve effective integration. Successful implementation depends on the alignment between digital tools, organisational processes, and operational workflows (Stoumpos et al., 2023). In this context, technology should be viewed as a supporting mechanism that enables integration and efficiency, rather than as an end. This perspective is particularly relevant for integrated care models, where the effectiveness of technological solutions is linked to organisational design and process integration (Ebo, 2025).

2.2. Local Health Unit of Matosinhos

The ULSM represents a relevant case of an integrated healthcare organisation within the Portuguese National Health Service. Its organisational structure and recent logistics initiatives provide the institutional and operational context necessary to frame the present internship and to support the analysis developed in this study.

2.2.1 Organisational Overview

The ULSM is a public healthcare organisation in Portugal that provides integrated healthcare services across multiple levels of care. Established in 1999 as the first LHU in the country, ULSM was designed to integrate primary, hospital, and continuing care under a single management structure, promoting coordination and continuity of care.

ULSM provides healthcare services to the population of the municipality of Matosinhos and ensures coverage of the full spectrum of healthcare services, including prevention, diagnosis, treatment, rehabilitation, and continuing care. The mission is to

guarantee accessible, integrated, human-centered healthcare, tailored to the needs of the local population and delivered with a strong focus on quality and safety.

The organisational structure of ULSM includes the Hospital Pedro Hispano, which serves as the central hospital facility, alongside an extensive primary healthcare network consisting of 14 Family Health Units, 2 Personalized Healthcare Units, and 2 Community Care Units. This integrated structure enables effective coordination between hospital services and community-based care.

In addition to its healthcare provision role, ULSM demonstrates a strong commitment to innovation and research, including participation in clinical trials and the development of initiatives aimed at continuous improvement. This strategic orientation has positioned ULSM as a national reference model for integrated care and coordination across distinct levels of the healthcare system (Unidade Local de Saúde de Matosinhos, E.P.E., 2023).

2.2.2 Hospital Logistics Initiatives at the Local Health Unit of Matosinhos

In line with its commitment to innovation and operational excellence, ULSM has recently implemented a pioneering hospital logistics management system, developed in partnership with Glintt Life, with the objective of modernizing and optimising its internal organisation processes (Unidade de Local de Saúde de Matosinhos, 2025).

This digital logistics system aims to enhance traceability and operational efficiency by supporting key logistics functions such as stock control, automated ordering processes, item location, optimising of internal distribution routes and delivery tracking. A distinctive feature of this initiative is its organisational scope, as it encompasses not only the main hospital (Hospital Pedro Hispano) but also the primary healthcare units integrated within ULSM, enabling a fully integrated organisation management approach across all services.

The expected impact of this initiative includes a significant increase in operational efficiency and reduction of waste, achieved through fewer handling errors and reduced material losses. Improved control and traceability of consumables and medicines also contribute to patient safety and service quality, which are critical dimensions to healthcare delivery.

Furthermore, the integrated logistics system strengthens coordination between hospital and primary care services, supporting continuity of care and aligning logistics operations more closely with actual demand patterns. By reducing both stockouts and excess

inventory, this approach is expected to generate economic and sustainability benefits, promoting more rational use of resources and improved supply chain performance (Unidade de Local de Saúde de Matosinhos, 2025).

Given the size and complexity of ULSM's integrated network, logistics plays a critical role in ensuring the continuous availability of materials across multiple care settings.

The implementation of this advanced logistics system provides a highly relevant context for the present internship, as it highlights the importance of aligning digital logistics solutions with the physical organisation of warehouses and internal logistic flows, which constitutes the central focus of this study.

2.3. Hospital Logistics

Hospital logistics has gained increasing attention in academic literature due to its growing impact on healthcare efficiency, quality of care and organisational performance. As hospitals face rising cost pressures, increasing complexity and higher expectations regarding patient safety and service quality, logistics have evolved from a purely operational support function into a strategic component of healthcare delivery.

This chapter reviews the relevant literature on hospital logistics, focusing on its strategic importance, the main problems and challenges currently identified, and the solutions proposed in previous studies. The chapter also highlights existing research gaps that justify the need for further investigation, particularly in the context of integrated healthcare organisations.

2.3.1 Strategic Importance of Hospital Logistics

Recent literature consistently highlights that hospital logistics has evolved from a set of purely operational activities, such as purchasing, inventory management and transportation, into a strategic function that is essential for overall hospital performance (Ageron et al., 2018; van der Ham et al., 2019; Beaulieu et al., 2020). Rather than operating in isolation, logistics is now recognized as a key enabler of efficiency, quality of care and organisational sustainability.

Hospital logistics directly influences service quality, waiting times, patient safety, and continuity of care, as the availability of materials and medicines is fundamental to clinical activity (Ageron et al., 2018). Inefficient logistics processes may lead to delays, disruptions in

care delivery and increased operational costs. Consequently, logistics performance is linked to both patient experience and clinical outcomes.

Several authors emphasize that meaningful logistics improvements depend on the integration of departments and flows, avoiding fragmented material, information, and patient pathways (van der Ham et al., 2019). Furthermore, logistics initiatives require organisational legitimacy and dedicated support from top management to generate sustained impact and overcome resistance to change (Beaulieu et al., 2020). In this sense, improving warehouse organisation and internal flows should be understood not merely as an operational adjustment, but as a strategic intervention with organisation-wide implications.

2.3.2 Current Problems and Challenges

Despite its recognized importance, hospital logistics continues to face significant challenges across healthcare systems.

One of the most frequently reported issues is the fragmentation of logistics processes. Van der Ham et al. (2019) identified 106 logistical parameters in hospitals and concluded that logistics are often highly fragmented, with limited integration between material flows, information systems, and patient pathways. This fragmentation leads to inefficiencies, duplication of activities, and poor visibility across the logistics chain.

Another major challenge is the lack of standardisation and a weak logistics culture within hospitals. Ageron et al. (2018) report that many healthcare organisations lack specialized logistics expertise, rely on bureaucratic procedures, and operate with inconsistent processes. Logistics is often perceived as a support activity rather than a strategic function, limiting its organisational legitimacy and impact.

In addition, hospital logistics processes are frequently complex and insufficiently digitalized. A systematic review of medical consumables logistics highlights that activities such as planning, reception, storage, distribution, and monitoring are often managed through manual or poorly integrated systems, resulting in long lead times and limited coordination (Karimah et al., 2022).

These challenges justify the need for detailed analysis of current logistics processes, including the use of process mapping, spaghetti diagrams, time-motion studies, and layout reviews (Daneshjo et al., 2021; Kalne et al., 2022). As fragmentation and lack of integration are widely recognized challenges in hospital logistics, analyzing the current state of the ULSM warehouse is a necessary step to identify inefficiencies and improvement opportunities.

2.3.3 Proposed Solutions and Evidence of Impact

Several studies provide evidence that structured logistics interventions can significantly improve hospital performance.

Advanced warehouse models and replenishment systems represent one such solution. A case study conducted at Hospital de Braga demonstrated that combining par-level systems, two-bin systems and consignment models, supported by information systems, resulted in stock reductions of up to 28.2% and 4.6%, while maintaining or improving material availability (Costa et al., 2015). These findings support the idea that warehouse organisation, picking zones and internal routes must be adapted to support automated and traceability-based systems, such as those currently being implemented at ULSM.

The concept of intelligent and integrated logistics has gained increasing importance in recent years. A case study conducted in a Smart Hospital in Shenzhen demonstrated that digital logistics systems can optimize internal routes, enhance integration between material and information flows and generate significant improvements in operational efficiency and energy performance (Yu et al., 2025). These findings indicate that digital solutions alone are not sufficient to achieve their full potential unless they are supported by optimized physical layouts and efficient internal logistics flows.

Karimah et al. (2022) conceptualize hospital logistics as a complete cycle, encompassing planning, reception, storage, distribution, and monitoring. This perspective reinforces that improvements at any single stage must be coherent with the entire logistics cycle. In this context, the benefits of ULSM's new traceability system could be maximised if the warehouse layout facilitates efficient picking, replenishment, expiry date control, ABC/XYZ classification, and optimized internal routing.

Finally, van der Ham et al. (2019) emphasize that logistics improvements are most effective when logistics is treated as an integrated system, rather than as isolated functional areas. This implies that warehouse optimization should consider flows between the warehouse, pharmacy and clinical services, reception, and dispatch areas, as well as integration with primary care units.

2.3.4 Research Gaps and Study Justification

Although hospital logistics has received increasing attention in recent years, the literature remains limited, particularly regarding comprehensive analyses of warehouse layout and internal logistics flows. While some studies address warehouse layout optimization in

hospital pharmacies (Beroule et al., 2017) and others focus on advanced warehouses supported by information systems (Costa et al., 2015), these approaches are often examined independently.

In the Portuguese context, existing studies have explored logistics reorganisation within specific services, such as the ambulatory pharmacy of LHUs (Castro et al., 2020). However, there is a lack of studies that provide a holistic and updated analysis combining physical warehouse layout, internal logistics flows and the implementation of new digital logistics systems within LHUs.

Overall, studies that jointly assess digital logistics transformation and physical layout reconfiguration in hospital warehouses remain scarce, particularly in Portugal. This gap justifies the present study, which aims to analyse and optimize the warehouse layout, and internal logistics flows at ULSM, ensuring alignment between newly implemented digital systems and operational practices.

3. Methodology

This chapter presents the methodology adopted in this study. Section 3.1 reviews the methodological foundations that support the research approach, while Section 3.2 describes the research methodology applied, including the research design, data collection, data analysis methods, and performance indicators.

3.1. Methodological Foundations

This section presents the methodological foundations that support the present study. The methodological approaches presented in this chapter build upon the same body of literature that underpins the discussion of hospital logistics challenges and improvement opportunities.

3.1.1 Methodological Approaches in Healthcare Operations and Logistics Studies

Research in healthcare operations and logistics is characterized by applied and context-dependent methodological approaches, reflecting the complexity of healthcare organisations and the interdependence between clinical and non-clinical processes. Several authors emphasize that logistics and operational processes in healthcare should be analysed as integrated systems, rather than as isolated functions, due to their direct impact on service quality, safety, and continuity of care (Ageron et al., 2018; van der Ham et al., 2019).

Given this complexity, case study approaches are frequently adopted in healthcare operations and logistics research. These approaches allow for an in-depth understanding of organisational processes, material flows, and structural constraints within real healthcare settings (Beaulieu et al., 2020). Case studies are particularly suitable for identifying inefficiencies, understanding interactions between departments, and proposing improvement actions that are adapted to the specific context of each organisation.

Furthermore, studies in this field often combine descriptive analysis with process-oriented methodologies, enabling researchers to examine how operational activities are performed and how they can be improved. This methodological orientation is consistent with the view that logistics improvements require organisational legitimacy and support from top management to generate meaningful and sustainable impact (Beaulieu et al., 2020).

3.1.2 Layout Optimization and Internal Flow Analysis in Healthcare

The optimization of physical layouts and the analysis of internal logistics flows are recurring methodological themes in healthcare operations research. Several studies suggest that warehouse layout design and internal routing significantly influence operational efficiency, affecting travel distances, handling times, error rates, and overall logistics performance (Beroule et al., 2017).

In hospital environments, poorly designed layouts often lead to fragmented flows and excessive internal movements, increasing operational complexity and reducing efficiency. Costa et al. (2015) show that reorganizing storage areas and internal routes, particularly when combined with structured replenishment models, can significantly improve stock management and service levels. These findings highlight the importance of aligning physical layouts with logistics processes.

Karimah et al. (2022) conceptualize medical consumables logistics as a complete and interconnected cycle, encompassing planning, reception, storage, distribution, and monitoring. From this perspective, layout optimization and internal flow analysis are critical methodological tools, as inefficiencies at the storage or movement level may compromise the performance of the entire logistics cycle. As a result, the literature consistently supports the use of layout analysis and flow mapping as core components of hospital logistics and healthcare operations studies.

3.1.3 Lean and Visual Management Approaches in Hospital Logistics

Lean management has been adopted in healthcare organisations as a strategy to improve operational efficiency, reduce waste, and enhance service quality. Originating from the Toyota Production System (TPS), Lean focuses on producing only what is needed, when it is needed, and in the required quantity, thereby minimizing excess inventory and operational inefficiencies (Sugimori et al., 1977). In healthcare settings, Lean principles have been applied to optimize the use of resources, streamline workflows, and support healthcare professionals in delivering timely and high-quality patient care (Lanza-León et al., 2021).

One of the fundamental aspects of Lean management is the elimination of waste, often referred to by the Japanese term muda. Waste includes any activity that consumes resources without adding value to the final service or product. By identifying and eliminating such activities, healthcare organisations can improve operational performance while maintaining or improving service quality (Lanza-León et al., 2021).

Among the various Lean tools applied in hospital logistics, Kaizen, 5S, and Visual Management play a particularly significant role in supporting continuous improvement and operational transparency.

The concept of Kaizen refers to a philosophy of continuous and incremental improvement that involves all employees in identifying inefficiencies and implementing small but consistent improvements in work processes. The term derives from the Japanese words kai (change) and zen (for the better). In practice, Kaizen initiatives often involve cross-functional teams that analyse existing processes, collect operational data, and propose solutions to eliminate waste and improve efficiency (Palmer, 2001). When applied to inventory management and logistics processes, Kaizen events can enhance visibility of stock levels, improve process standardisation, and reduce operational lead times.

Another widely used Lean methodology is the 5S system, which aims to improve workplace organisation and efficiency through five sequential steps: sort (seiri), set in order (seiton), shine (seiso), standardize (seiketsu), and sustain (shitsuke). In hospital logistics environments, the implementation of 5S contributes to better organisation of storage areas, improved accessibility of medical supplies, and enhanced process standardisation. According to Landry and Beaulieu (2010), applying 5S principles to hospital replenishment systems helps optimize the use of storage space and ensures that materials are arranged in a structured and easily accessible manner.

Closely related to these approaches is Visual Management, which involves the use of visual signals and indicators to communicate operational information quickly and effectively. Examples include color-coded labels, visual stock indicators, and standardized visual identification systems within storage areas. These visual tools allow staff to quickly identify material availability and detect potential stock shortages, improving responsiveness and reducing errors (Landry & Beaulieu, 2010). In hospital environments where rapid decision-making is often required, visual management systems can significantly support operational efficiency and enhance coordination among staff.

Overall, the integration of Lean tools such as Kaizen, 5S, and Visual Management has demonstrated considerable potential for improving hospital logistics processes. These approaches support continuous improvement, enhance workplace organisation, and facilitate more efficient management of healthcare resources.

3.1.4 Inventory Control and Traceability Systems

Effective inventory control is a critical component of hospital logistics, as the availability of medical supplies directly influences the continuity and quality of patient care. Healthcare institutions must therefore implement reliable inventory management systems capable of ensuring adequate stock levels while minimizing waste, operational delays, and excess inventory.

One of the most widely adopted inventory control methods is the Kanban system, which is based on a pull replenishment principle. Originally developed within the TPS, Kanban operates through visual signals, typically cards or containers, which trigger the replenishment of materials when they are consumed (Schonberger, 1983). Unlike traditional push systems that rely on demand forecasting and scheduled production, Kanban ensures that materials are replenished based on actual consumption, thereby reducing excess inventory and improving material flow.

The application of Kanban systems in healthcare logistics has been associated with several operational benefits. These include improved inventory control, reduction of stock levels, increased responsiveness to demand fluctuations, and improved supply chain coordination (Lanza-León et al., 2021). In addition, studies suggest that Kanban implementation in hospital supply chains can reduce the workload associated with inventory management tasks performed by healthcare staff, allowing them to focus more on patient care activities (Aguilar-Escobar et al., 2015).

A common variation of the Kanban system used in healthcare logistics is the two-bin system, also known as the double-bin system. In this approach, each product is stored in two separate compartments. The first compartment is used for regular consumption, while the second serves as a reserve stock. Once the first bin becomes empty, it triggers a replenishment signal while the second bin continues to supply the materials until the restocking process is completed (Aguilar-Escobar et al., 2015). This method simplifies inventory control by eliminating the need for frequent stock counting and by establishing a standardized replenishment process.

Research has shown that two-bin Kanban systems can significantly improve hospital replenishment processes. For example, they can accelerate ordering procedures, improve stock rotation, and reduce the number of expired items. Furthermore, they help decrease the time healthcare professionals spend on logistics tasks, contributing to improved operational efficiency (Aguilar-Escobar et al., 2015).

More recently, healthcare organisations have begun integrating Radio Frequency Identification (RFID) technology with Kanban-based systems to enhance inventory traceability and automation. RFID technology uses electronic tags to identify and track materials automatically throughout the supply chain. When combined with Kanban systems, RFID can provide real-time inventory visibility, automatically detect stock movements, and generate replenishment signals without manual intervention (Landry & Beaulieu, 2010). This technological integration allows healthcare organisations to proactively manage inventory levels and reduce the risk of stockouts.

In conclusion, inventory control systems such as Kanban, two-bin replenishment methods, and RFID technologies represent effective solutions for improving material management in hospital logistics. Their implementation contributes to more efficient supply chain operations, better inventory visibility, and improved support for clinical activities.

3.1.5 Data Collection and Analysis Methods Used in Previous Studies

Previous studies in healthcare logistics and operations rely on operational and secondary data to evaluate logistics performance and identify improvement opportunities. Common data sources include inventory records, system-generated logs, material movement histories, and time-related operational data collected during routine activities (Karimah et al., 2022; Costa et al., 2015).

Methodologically, literature frequently applies process mapping techniques, flow analysis, and time and distance measurements to assess inefficiencies in logistics systems. Time and motion studies are widely used to analyse operational efficiency and workflow performance across different sectors, including healthcare logistics (Nicolle et al., 2022). Van der Ham et al. (2019) highlight that such methods are essential for identifying fragmentation across logistics processes and for understanding the interactions between material, information, and patient flows.

In addition, previous research emphasizes the importance of performance measurement in logistics improvement initiatives. A systematic review highlights the relevance of key performance indicators in evaluating hospital supply chain efficiency and supporting decision-making (Fallahnezhad et al., 2024). Similarly, the use of key performance indicators has been widely adopted to assess warehouse efficiency and overall operational performance (Chen et al., 2017). Inventory classification techniques, such as ABC and ABC–

XYZ analysis, are also commonly applied to support storage organisation and prioritization decisions within hospital warehouses (Karimah et al., 2022).

Overall, these data collection and analysis methods provide a structured and evidence-based foundation for evaluating current logistics configurations and supporting improvement proposals. Their widespread use in previous studies reinforces their relevance and suitability for applied research in healthcare operations and logistics.

3.1.6 Logistics Performance Measurement

Performance measurement is a fundamental component of logistics management, as it enables organisations to evaluate processes, identify inefficiencies, and support continuous improvement initiatives. In warehouse management, the use of Key Performance Indicators (KPIs) allows managers to objectively monitor logistics activities and evaluate the effectiveness of implemented improvements (Chen et al., 2017). In healthcare environments, where logistics processes directly influence the availability of medical supplies and the continuity of patient care, monitoring logistics activities is particularly important to ensure efficient and reliable operations (Fallahnezhad et al., 2024).

The literature highlights that logistics activities should be evaluated using a combination of complementary indicators rather than relying on a single measure. Considering different dimensions simultaneously provides a more comprehensive understanding of warehouse operations and enables meaningful comparisons between alternative layouts, picking strategies, and operational procedures (Chen et al., 2017; van der Ham et al., 2019). Among these dimensions, distance, time, and efficiency are consistently identified as key measures for assessing warehouse operations and evaluating the impact of improvement initiatives (Chen et al., 2017; Fallahnezhad et al., 2024).

Distance-related indicators are widely adopted in warehouse optimization studies because they quantify the movement required to perform order-picking activities. Since operator travel represents a considerable proportion of picking operations without adding value to the service provided, reducing travelled distance has become one of the primary objectives of warehouse layout redesign and route optimization. Consequently, distance-based measures are commonly used to compare alternative warehouse configurations and quantify the benefits achieved through improvement initiatives (Beroule et al., 2017).

Time-related indicators represent another essential dimension for evaluating logistics activities. By measuring the duration of operational tasks, these metrics help identify

bottlenecks, compare different operational scenarios, and assess the effects of process improvements. Consequently, time and motion studies have become widely adopted approaches for analysing workflows and supporting continuous improvement initiatives (Nicolle et al., 2022).

Efficiency-related measures complement distance and time-based evaluations by assessing how effective logistics resources are utilized throughout warehouse operations. When analysed together, these dimensions provide a comprehensive understanding of logistics processes and support objective evaluations of the outcomes achieved through operational improvements (Chen et al., 2017; Fallahnezhad et al., 2024).

Based on these principles, the present study evaluates the internal distribution process using a set of complementary indicators related to travel distance, execution time, and operational efficiency. Together, these measures enable a comparison of warehouse operations before and after the implementation of the proposed improvements, allowing the impact of the interventions to be objectively assessed. The specific indicators selected for this study are presented in Section 3.2.6.

3.2. Research Methodology

3.2.1 Research Design

This internship report adopts a case study approach, as the work was carried out within the real operational context of the Logistics Department of the ULSM. The case study approach was considered the most appropriate because it enabled an in-depth understanding of the warehouse operation, the identification of existing logistical challenges, and the development of improvement proposals tailored to the organisation's specific context.

The work undertaken during the internship followed an applied approach, focusing on addressing operational challenges identified within the warehouse environment. The study began with an analysis of the existing logistics processes to understand the current operation and identify opportunities for improvement. Based on this diagnosis, several improvement initiatives were developed to optimize warehouse organisation, inventory management, and internal distribution activities. While some of these initiatives were implemented during the internship, others were proposed as recommendations for future implementation. Their effectiveness was evaluated by comparing warehouse performance before and after the implemented changes or, where implementation was not feasible, by assessing the expected operational improvements.

To support the development of the study, both qualitative and quantitative methods were employed. Qualitative information was obtained through direct observation of warehouse activities, analysis of existing procedures and internal documentation, and regular interaction with the logistics team, providing a comprehensive understanding of the operational context. Quantitative data was collected through measurements of warehouse activities and operational indicators, enabling an objective assessment of the proposed improvements.

Overall, the adopted research design provided a structured framework for analysing the existing warehouse operation, developing and evaluating improvement initiatives, and assessing their impact through objective performance measures. This approach ensured that the recommendations presented in this report were based on the operational needs identified during the internship and supported by the evidence collected throughout the study.

3.2.2 Research Framework

The work developed during the internship followed a structured methodological framework composed of several sequential stages. This framework ensured a systematic approach to understanding the warehouse operation, identifying improvement opportunities, developing appropriate solutions, and evaluating their impact. Figure 1 presents the research framework adopted throughout the internship.

Each stage of the framework is briefly described below.

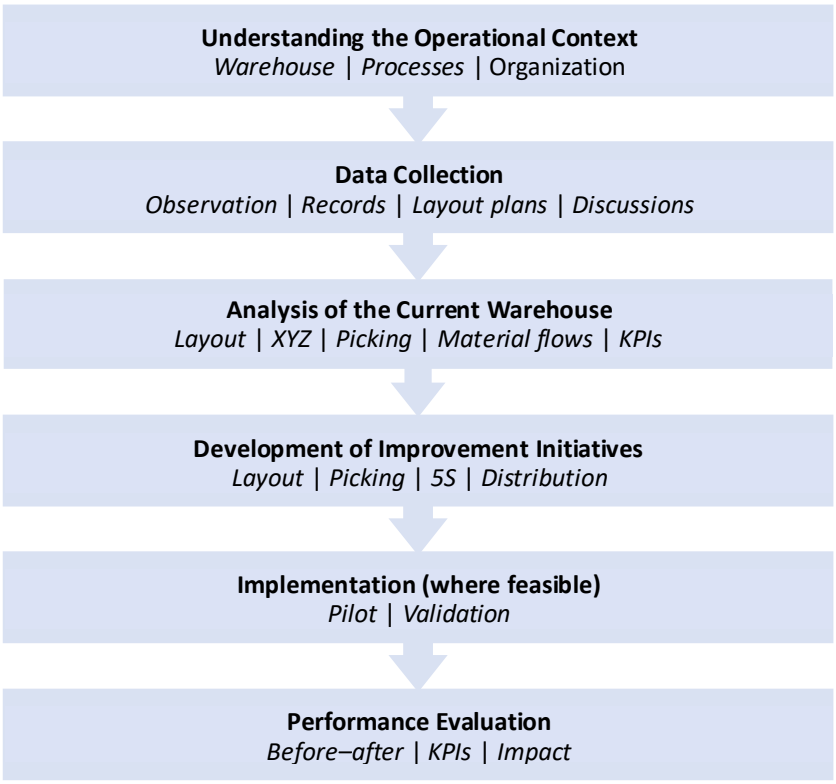


Figure 1 - Research framework adopted during the internship.

The first stage consisted of understanding the operational context of the Logistics Department, including the warehouse organisation, inventory management practices, and internal distribution processes. This initial phase provided the necessary knowledge of the existing operation and its constraints.

The second stage involved collecting the information required for the study through direct observation, analysis of internal documentation, operational records, and regular interaction with warehouse personnel. Quantitative data, including warehouse measurements and operational indicators, were also collected to support the subsequent analysis.

Based on the information collected, an analysis of the current warehouse operation was conducted to identify inefficiencies and opportunities for improvement. This assessment focused on warehouse organisation, storage allocation, inventory management, and internal distribution activities.

Following the diagnosis, several improvement initiatives were developed to address the identified operational challenges. Depending on their feasibility within the internship period, some initiatives were implemented, while others were proposed as recommendations for future implementation.

Finally, the effectiveness of the implemented improvements was assessed using the selected performance indicators, while the expected impact of the remaining proposals was evaluated based on the analysis conducted throughout the study. This final stage enabled the overall contribution of the proposed interventions to be assessed.

3.2.3 Data Collection

The data collection process was carried out throughout the internship period, from 23 February to 12 June 2026, combining qualitative and quantitative methods to obtain a comprehensive understanding of the warehouse operation and to support the development and evaluation of the proposed improvement initiatives.

Operational data provided by the Logistics Department constituted one of the main sources of information used in this study. These data included warehouse layout plans, product location records, stock information, inventory consumption data, and picking records. The analysis of these documents enabled the characterization of the existing warehouse operation and supported the identification of inefficiencies and opportunities for improvement.

In parallel, direct observation was conducted daily throughout the internship. This involved observing warehouse activities and accompanying warehouse operators during their daily work to gain a thorough understanding of the operational workflow, picking procedures, inventory management practices, and internal distribution activities. Attention was given to the routes followed by the operators, the execution of warehouse tasks, and the operational constraints encountered during routine activities.

Additional qualitative information was obtained through regular informal discussions with the senior logistics technician and warehouse operators. These discussions helped clarify existing procedures, validate observations made during the internship, and gather practical insights into the challenges faced in the daily operation of the warehouse, as well as potential opportunities for improvement.

Quantitative data were collected through direct measurements of warehouse activities, including travel distances within the warehouse, picking times, and the duration of internal distribution routes. Measurements were performed both before and after the implementation of selected improvement initiatives, enabling an objective comparison of operational performance. Furthermore, photographic records were taken throughout the internship to document the initial warehouse configuration and the implemented changes,

providing visual support for the comparison between the initial and improved warehouse conditions.

3.2.4 Data Processing Tools

Several digital tools and technological devices were used throughout the internship to support the collection, organisation, processing, and analysis of the data required for this study.

The hospital's Data Discovery platform was used as the primary source of operational data, providing information on product consumption, stock levels, product locations, and daily picking records. Additional operational data and performance information were provided by the Logistics Department through Power BI dashboards, complementing the information extracted from the hospital's information systems.

The data collected were organized, processed, and analysed using Microsoft Excel, which served as the main tool throughout the study. Excel was used to structure and clean the datasets, perform calculations, analyse operational indicators, compare the initial and improved scenarios, and support the evaluation of the proposed improvement initiatives.

To better understand the warehouse operation, the Personal Digital Assistant (PDA) used by warehouse operators was observed during the internship. This device allowed the analysis of the picking workflow, the sequence of tasks performed during order preparation, and the interaction between operators and the warehouse management system.

A smartwatch was used during the data collection phase to measure the time required to complete warehouse activities and the number of steps taken while performing picking operations and internal distribution routes. To estimate the travel distances, the recorded number of steps was converted into metres using the simplifying assumption of one metre per step. This approach provides an estimate rather than a direct measurement of the actual distance travelled, as step length may vary between operators and according to walking conditions. Therefore, the distances reported in metres should be interpreted as approximate values and are primarily used to provide a consistent basis for comparing the different route configurations.

3.2.5 Data Analysis Methods

The data analysis process followed a structured methodology aimed at identifying operational inefficiencies, developing improvement initiatives, and evaluating their impact

on warehouse performance. Different analytical methods were applied throughout the internship according to the objectives of each stage of the study.

Initially, the warehouse inventory was analysed using the existing XYZ classification adopted by the Logistics Department. This classification, based on the variability of product consumption, was already integrated into the hospital's inventory management practices and was used as the main criterion for reviewing the storage locations of the items. Products with more stable demand were prioritized for storage in more accessible locations, contributing to a more efficient warehouse organisation and reducing unnecessary operator movements during picking activities.

The warehouse layout was then analysed through direct observation, consultation of warehouse layout plans, photographic records, and the measurement of travel distances and execution times. Warehouse operators were observed during their daily activities to better understand the operational workflow and identify opportunities for improvement. This analysis made it possible to identify underutilized storage areas, locations where similar products could increase the likelihood of picking errors, and operational constraints affecting warehouse efficiency.

To evaluate the efficiency of the picking process, the existing picking routes were analysed by tracing the operators' movements on warehouse layout plans and constructing Spaghetti Diagrams. The travelled distances were estimated by converting the recorded number of steps into metres, while the execution time of each route was also measured. The analysis focused on identifying redundant movements, unnecessary travel, and opportunities to optimize the picking sequence. Following the redesign of the picking routes, the same methodology was applied to evaluate the new workflow and compare its performance with the initial situation.

Additional assessment methods were also applied to support the overall analysis of warehouse operations. The existing Kanban system was reviewed to understand its contribution to inventory management, while a 5S audit was conducted to assess workplace organisation and identify opportunities for improving orderliness and operational efficiency.

Finally, the effectiveness of the implemented improvement initiatives was assessed using comparisons between the initial and improved configurations where direct operational measurements were available. For the picking-route redesign, a controlled comparison was additionally conducted by keeping execution time and the number of picked items constant and recalculating the estimated travel distance according to the proposed sequence.

3.2.6 Performance Indicators

The effectiveness of the proposed improvement initiatives was evaluated using a set of operational performance indicators. These indicators enabled an objective comparison between the initial warehouse configuration and the improved scenarios, focusing on the efficiency of picking activities and internal distribution processes. Table 1 summarizes the performance indicators adopted in this study.

Table 1 - Operational performance indicators used to evaluate the proposed improvement initiatives.

Indicator	Formula	Purpose
Total Time	Measured time (min)	Evaluate the total time required to complete a picking route.
Average Time per Item	Total Time / Number of Picked Items	Assess the average time required to collect each item.
Zones	Number of warehouse zones visited	Evaluate the extent of warehouse areas covered during each picking route.
Average Time per Zone	Total Time / Number of Zones	Assess the average time spent in each warehouse zone.
Distance (metres)	Measured distance (m)	Evaluate the total distance travelled during the picking route.
Average Distance per Item	Distance / Number of Picked Items	Assess the average travel distance required to collect each item.
Efficiency	Number of Picked Items / Distance	Evaluate the relationship between the number of items collected and the distance travelled, indicating the efficiency of the picking route.
Average Speed	Distance / Total Time	Assess the average speed during route execution and support comparisons between different picking routes.

These indicators were measured before and after the implementation of the proposed improvement initiatives, enabling an objective assessment of the impact of the changes on the efficiency of warehouse picking operations. Note that average Speed was calculated as the ratio between estimated travel distance and route execution time. However, in the comparison between the initial and updated routes, execution time was kept constant. Therefore, changes in average speed are a direct mathematical consequence of changes in estimated distance and should not be interpreted as changes in operator performance or route execution speed.

4. Logistics and Warehouse Operations at ULSM

This chapter aims to analyse the logistics system of ULSM, with a particular focus on the clinical warehouse. The main aspects related to space organisation, material flows, stock management systems, and picking operations are addressed, while also identifying opportunities for improvement and evaluating the interventions implemented within the context of logistics operations optimization.

4.1. Characterization of the Logistics Service

Before analysing the warehouse operations in detail, it is important to understand how the ULSM LS is organized, since the warehouse operates in coordination with the different consuming departments.

The LS is divided into several operational areas. One of these areas is the Clinical Archive Unit, responsible for the digitization, integration into the electronic health record, and archiving of documentation originating from Hospital Pedro Hispano and primary healthcare centres.

Another relevant area is the Transport Sector, responsible for the movement of materials, documents, and samples between the different hospital departments, healthcare centres, and other units external to ULSM. This function is conducted by couriers and by a team of drivers composed of both ULSM employees and staff from a subcontracted company.

The LS also includes a supermarket planning department, responsible for the design and organisation of the supermarkets (two-bin stock systems) existing at Hospital Pedro Hispano and within ULSM primary healthcare units. The definition of the products included in each supermarket, as well as their layout, is conducted in collaboration with the nurse managers of the different departments, ensuring that the available materials correspond to the operational needs of each unit.

The LS is responsible for the reception, storage, picking, and distribution of several types of materials, including clinical, hospitality-related, administrative, maintenance and conservation materials, as well as fixed assets.

To ensure the proper functioning of the processes associated with the logistics supply chain, management, monitoring, and follow-up activities are also conducted, ensuring continuity of supply and efficiency of the logistics flow.

After the reception of materials by the LS, the items may follow different flows depending on their typology and destination. Stockable items are sent to the warehouse, where they remain stored until they are later prepared and distributed to the different hospital departments.

On the other hand, non-stockable items follow a cross-docking process, being sent directly to the respective consuming departments without the need for intermediate storage in the warehouse. This process reduces the time materials remain within the logistics system and makes the flow more efficient.

There is also a flow associated with warehouses external to the LS, namely SIES, Clinical Pathology, Hemotherapy, Anatomical Pathology, and Hospitality Services. In these cases, the physical verification of materials is conducted by the departments themselves, while the LS ensures the computerized reception process.

In addition to these activities, the LS also provides support to the Pharmaceutical Service, particularly in tasks related to material reception, storage, order follow-up, non-conformity management (NCR), as well as picking operations for serums and disinfectants and the distribution of materials to the different hospital departments.

To better understand the coordination between the LS and the different warehouses, Table 2 presents the stages of the logistics process in which the LS intervenes, namely in reception, verification, entry registration, storage, picking, and dispatch registration operations.

Table 2 - Intervention of the LS in the distinct stages of the warehouse logistics process

Warehouse	Purchase Orders	Follow-up	Reception	Verification	Entry Registration	Storage	Picking	Dispatch Registration	Distribution
10 - Clinical	LS	LS	LS	LS	LS	LS	LS	LS	LS
12 - Hospitality									
15 - Administrative									
18 – Maintenance / Conservation									
99 - Reagents									
ABT - Write-offs	NA	NA	NA	NA	LS	LS	NA	LS	NA
DEV - Returns	NA	NA	NA	NA	LS	LS	NA	LS	NA
01 - Pharmacy	Pharmacy	LS	LS	LS	LS	LS	LS Pharmacy	LS Pharmacy	LS
UPC - Cytotoxics	Pharmacy	LS	LS	LS	LS	LS	Pharmacy	Pharmacy	LS
FA1 - Outpatient Clinic									Pharmacy

FA2-ONC - Outpatient Clinic 2 (Oncology)									
VAC - Vaccines									LS
PC1 - Advanced Clinical Pathology	PC		LS	PC	LS	PC	PC	PC	NA
AP1 - Advanced Anatomical Pathology	AP		LS	AP	LS	AP	AP	AP	NA
HEM1 - Advanced Hemotherapy	HEM	LS	LS	HEM	LS	HEM	HEM	HEM	NA
HOT - Advanced Hospitality Services	SH		LS	SH	LS	SH	SH	SH	SH
50 - Facilities and Equipment	SIE		SIE	SIE	SIE	SIE	SIE	SIE	SIE

*Note: PC – Clinical Pathology; AP – Anatomical Pathology; HEM – Hemotherapy; SH – Hospitality Services; SIE – Facilities and Equipment Service; NA – Not Applicable.

Figure 2 presents the organisational structure of the Logistics Department and the main functional areas that interact with the warehouse.

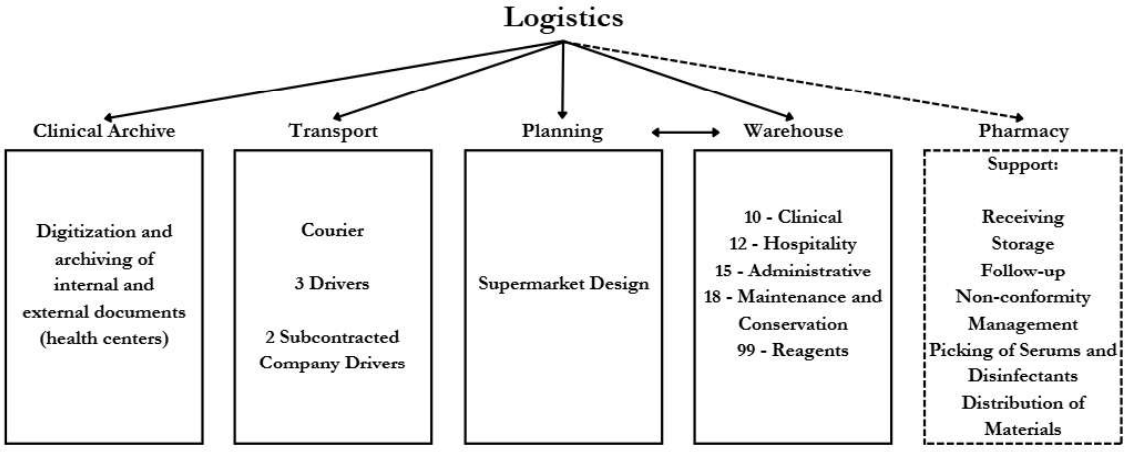


Figure 2 - Organisational Structure of the Logistics Department

This structure highlights the significant role of the warehouse within the institution's logistics system, functioning as the main link between material procurement and distribution to the different hospital departments.

4.1.1 Warehouse Organisation and Layout

After presenting the organisational structure of ULSM logistics, it becomes necessary to understand how the warehouse is organized, as well as the physical arrangement of materials within the available space.

In general, the ULSM logistics system consists of distinct types of warehouses, namely clinical, hospitality, administrative, reagents, and maintenance and conservation warehouses.

The present work focuses on Warehouse 10 – Clinical Materials Warehouse, since it concentrates most of the materials used in clinical activities and presents greater complexity in terms of stock management and logistics operations.

To understand the distribution of products within the logistics system, the number of stockable items existing in each warehouse was also analysed. As can be observed in Table 3, the clinical warehouse concentrates most stockable items, reflecting the high diversity of materials required to support clinical activities.

Table 3 - Number of Stockable Items per Warehouse

Warehouse	**Total Stockable Items**
10 - Clinical	788
12 - Hospitality	49
15 - Administrative	166
18 - Maintenance and Conservation	42
99 - Reagents	5
Total	**1050**

The clinical warehouse is subdivided into several storage areas, organized according to the type of material and operational requirements. These areas include Insulins, General, Golden, Colostomy, Specific, Pallets, Operating Block, Sterilization, Sutures, Reagents, and Monos. This division allows the structuring of product storage and facilitates the execution of the picking routes conducted by logistics operators.

Additionally, each area is identified by a specific colour, allowing rapid visual identification of the different warehouse zones (Figure 3). This colour differentiation constitutes an element of visual management, facilitating operators' orientation during logistics operations and contributing to greater efficiency in product location and collection.

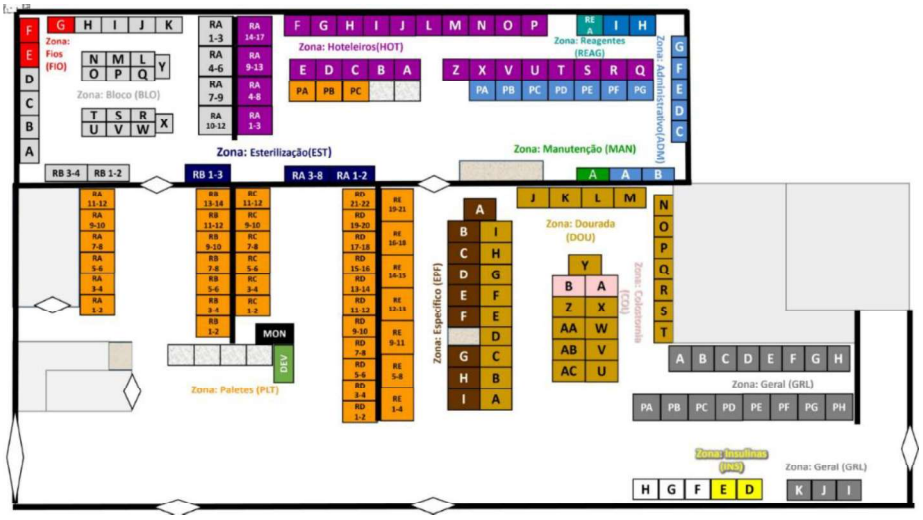


Figure 3 - Warehouse Layout

In addition to the division into zones, the warehouse also presents a hierarchical location structure, which organizes products according to a warehouse, zone, pallet rack, shelving unit, and shelf logic. This structure, referred to as the location tree, allows the precise identification of the position of each item and ensures greater efficiency in picking operations.

Figure 4 presents an example of the location tree associated with the clinical warehouse (Warehouse 10), where it is possible to visualize the organisation of the different zones and their respective locations.

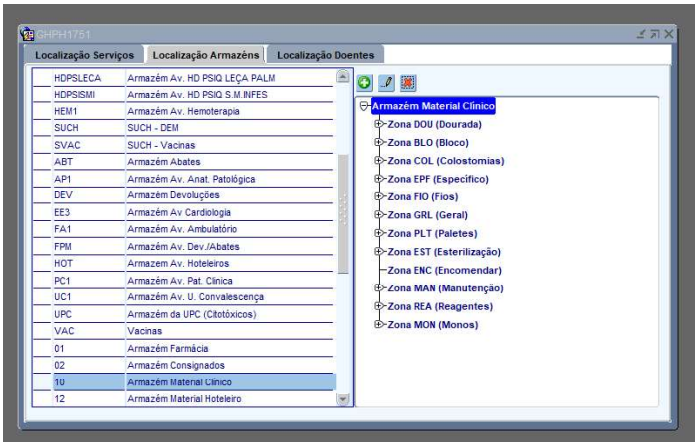


Figure 4 - Location Tree Associated with the Clinical Warehouse

Each rack and its respective shelves are associated with a picking route, which defines the order in which operators move through the warehouse during picking operations. This

organisation allows the structuring of operators' routes and reduces unnecessary movements during the order preparation process.

However, whenever a change occurs in the physical structure of the warehouse, such as the addition of new shelves or the reorganisation of racks, it becomes necessary to update the picking order defined in the system. This update ensures that the routes displayed on the Personal Digital Assistant (PDA) used by the operators continue to correctly reflect the physical arrangement of products within the warehouse.

Figure 5 presents an example of the composition of a shelving unit located in the Operating Block Zone, highlighting the organisation of its respective shelves.

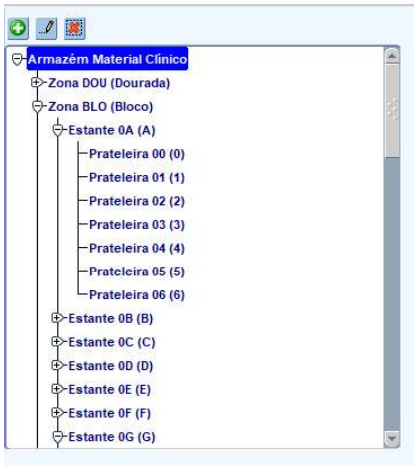


Figure 5 - Organisation of a Rack in the Operating Block Zone within the Logistics Management System

The clinical warehouse stores stockable products, that is, items for which stock is available. In contrast, non-stockable products are not kept in storage, being normally requested directly by the consumer departments and subsequently purchased from the supplier.

Both stockable and non-stockable products may supply supermarkets and electronic requests. In the case of stockable products, immediate warehouse availability exists, allowing a rapid response to the departments' needs. In the case of non-stockable products, the arrival of the supermarket box at the warehouse triggers the procurement process, subsequently leading to the generation of a purchase order to the supplier and becoming dependent on the respective lead time.

Regarding the logistics management of materials, warehouse operations involve different movements associated with product circulation. Goods reception represents the entry of products previously ordered from the supplier. After reception, items follow different processes depending on whether they are stockable or non-stockable: the former

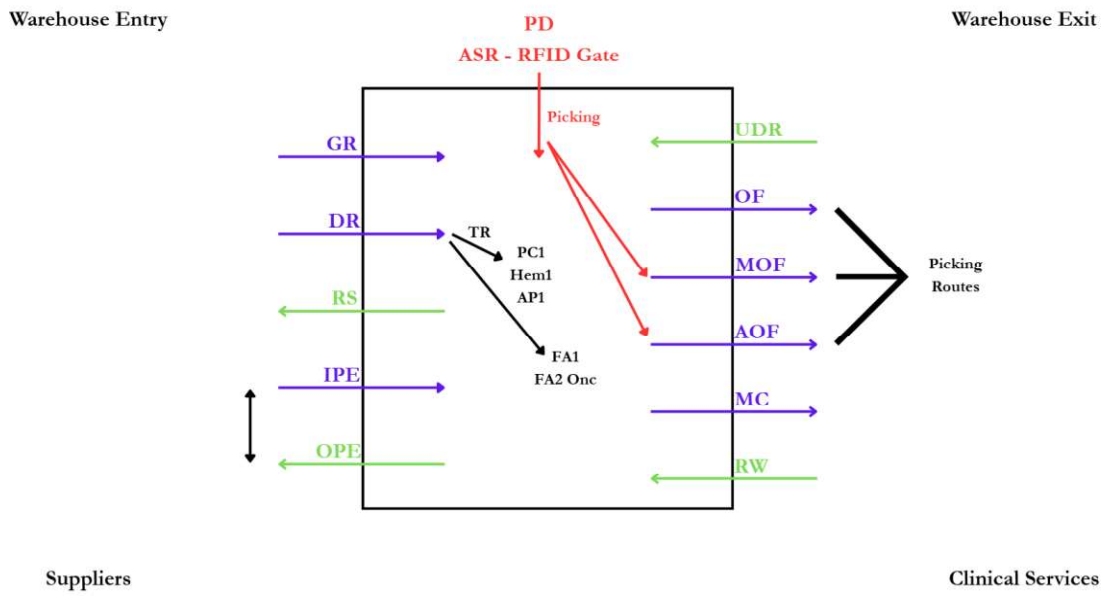
are stored in the warehouse, while the latter follow a direct reception process and are sent to the respective departments.

After reception, stockable products are stored in their respective locations and made available for picking and subsequent distribution. The fulfilment of departments' needs may be ensured through two flows:

- Flow A – Traditional electronic requests: departments place requests electronically, indicating the required items and quantities (PD - Requests).
- Flow B – Supermarket replenishment (two-bin system):
    - With RFID: the passage of boxes equipped with RFID tags through the warehouse gate automatically triggers a request in the Automatic Stock Replenishment (ASR) system.
    - Without RFID: replenishment is conducted through Kanban collection, subsequently allowing the picking operation and the manual registration of item dispatches in the system (MC - Material Consumption).

Finally, other logistics operations may also occur, such as returns to suppliers, returns to the warehouse, or product exchanges, which are likewise part of the warehouse operational activities.

Figure 6 presents the main warehouse movements associated with the management and circulation of materials.



*Note: PD – Requests; ASR - Automatic Stock Replenishment; GR - Goods Reception; DR - Direct Reception; RS - Return to Supplier; IPE - Incoming Product Exchange; OPE - Outgoing Product Exchange; UDR - Unit-Dose Return; OF - Order Fulfilment; MOF - Multiple Order Fulfilment; AOF - Automatic Order Fulfilment; MC - Material Consumption; RW - Return to Warehouse.

Figure 6 - Logistics Movements Associated with Warehouse Operations

To summarize these activities, it is possible to identify a sequence of processes that structure the overall functioning of the warehouse, from the reception of materials to their distribution.

Figure 7 presents a schematic representation of the processes associated with warehouse operations.



Figure 7 - Warehouse Processes

4.1.2 Inventory Management System in the Warehouse and Supermarkets

Stock management is based on the application of Kaizen methodology principles within the Lean approach and is operationalized using the Kanban system and the two-bin model. These mechanisms allow the adjustment of material flows between the central warehouse and the departments according to actual consumption.

Within the warehouse, stock level control is conducted through kanbans, which function as visual signals to trigger internal replenishment or procurement processes for specific items.

In the departments, the two-bin system is implemented to make material consumption visible and to trigger the picking and replenishment process from the warehouse, ensuring continuity of supply. In this context, some items are equipped with RFID tags, enabling the partial automation of the replenishment process and enhancing the reliability and traceability of stock control.

The integration of these mechanisms makes it possible to establish a continuous replenishment system (pull system) between the warehouse and the departments, ensuring the availability of materials required for clinical activities while promoting efficient and optimized stock management.

The following sections provide a detailed description of the operation of the Kanban system within the warehouse and the two-bin system implemented in the logistics supermarkets integrated into the ULSM system.

4.1.2.1 Kanban System in the Warehouse

Each item stored in the warehouse has an associated kanban, which functions as an identification and operational management element. This kanban contains relevant information, namely the item description, its warehouse location, the barcode supporting the picking process, the reorder point (ROP), the order quantity (OQ), and the respective unit of measure.

The OQ corresponds to the defined replenishment volume for the item, while the ROP represents the minimum stock level established to ensure coverage of requirements during both the internal and supplier lead times. Whenever the stock level reaches the ROP, the replenishment process is triggered through the delivery of the kanban to the stock management team of the LS.

After the reception of the material, the kanban is repositioned at the location corresponding to the ROP. When the operator withdraws the last product up to that limit, the kanban must be removed and placed in the designated area for signalling replenishment needs. Based on this signal, the LS issues the purchase request, which is subsequently formalized by the Purchasing Department through the issuance of the respective purchase order. Figure 8 presents an example of a Kanban used in the warehouse.



Figure 8 - Kanban card of a specific item

4.1.2.2 Supermarket System and Two-Bin Method

In ULSM hospital departments, the supply of clinical materials is supported by a supermarket system inspired by the principles of Lean Management and TPS. These supermarkets correspond to storage areas located within the different hospital departments, where the materials required for clinical activities are made available. The selection of the products included in each supermarket, as well as their respective quantities, is defined collaboratively between the logistics planning team and the managers of each department, ensuring that the available materials correspond to operational needs. Figure 9 presents a supermarket located within a specific hospital department for the storage of supplies.



Figure 9 - Example of a Supermarket Used in ULSM Hospital Departments

Within these areas, materials are organized according to the two-bin method. Each product is stored in two SUC boxes. When the first box becomes empty, it is removed and sent to the logistics warehouse, signalling the need for replenishment. Meanwhile, the second box ensures the continuity of product supply until the replenishment process is completed, thereby initiating a new replenishment cycle. This process is illustrated in Figure 10.

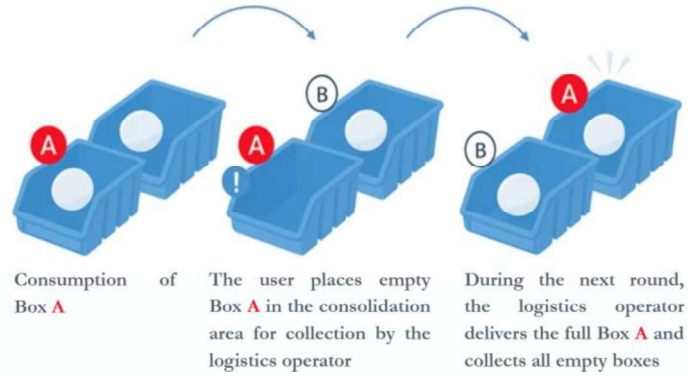


Figure 10 - Operation of the Two-Bin System Used in Hospital Supermarkets

The relationship between the supermarkets and the warehouse is ensured through this replenishment mechanism. After the empty boxes return to the warehouse, the way in which the replenishment request is generated depends on whether RFID tags are associated with the boxes.

For products equipped with RFID, the passage of the boxes through the gate located in the warehouse automatically triggers a request in the ASR system, which is subsequently integrated into the picking routes conducted by logistics operators using PDAs. For products that do not have this technology, consumption is manually recorded on the PDA during the replenishment process so that it can be correctly charged to the corresponding cost centre. In this case, the replenishment process is decided by the operator rather than by the picking route.

After the requests are generated, operators perform the picking of the required products in the warehouse, organizing them into distribution trolleys usually grouped by floor or department. Subsequently, the materials are distributed to the different hospital departments, where they are placed back into the supermarkets, restoring the stock levels required for the functioning of clinical activities.

In certain situations, stockouts may occur in the warehouse, making the immediate replenishment of the requested product impossible. In such cases, this situation is identified in the supermarkets through visual signalling. For some RFID-equipped products, passage through the gate may also automatically generate a request to the Purchasing Department, with these items being treated as non-stockable products. In the remaining cases, the process follows a traditional logic: the Kanban card identified for replenishment is placed in a specific location within the warehouse, initiating the procurement process through the issuance of a purchase request, which subsequently results in a purchase order being sent to the supplier.

4.1.3 Picking Routes

Picking routes play a fundamental role in warehouse operational performance, directly influencing the efficiency of order preparation. In this context, the existing routes are analysed and opportunities for improvement are identified, with the aim of optimising travel paths and logistics operations.

4.1.3.1 Initial Route

Material restocking operations in the consuming services require the execution of predefined picking routes for each zone. These routes are presented to the operators through the PDA, which indicates the sequence for item collection based on the product locations defined in the system.

The order in which the products are displayed on the PDA results from the sequence previously configured in SGICM, which establishes a picking sequence associated with the different zones, racks, and shelves. Thus, whenever an operator starts picking an item, the system presents the predefined sequence.

Figure 11 identifies the different warehouse zones and the order in which they should be passed through during the picking process. The green marker indicates the starting point of the route, while the red marker identifies the last item in the picking route.

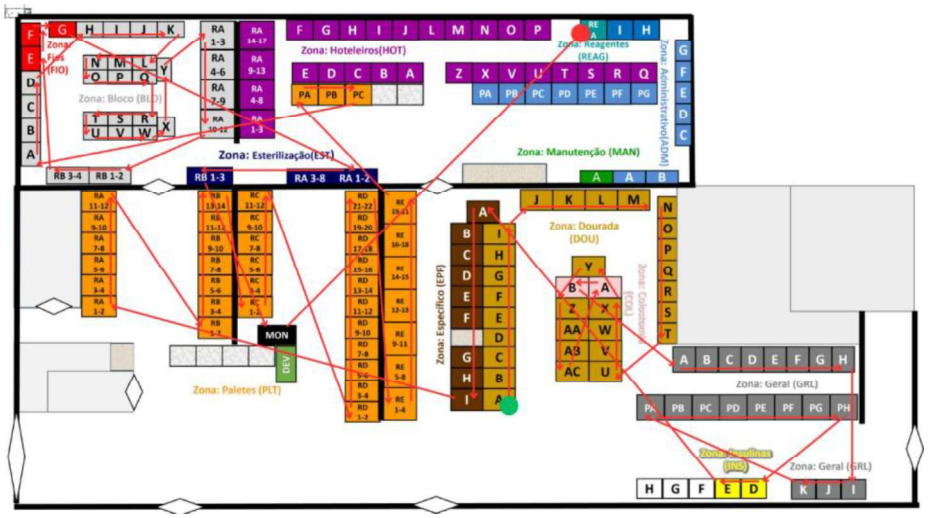


Figure 11 - Initial Picking Sequence

Although this sequence represents the structure defined in the system, it was observed during the internship that the order presented does not always correspond to the most efficient route within the warehouse. In some cases, the picking sequence may require operators to return to previously visited corridors or move between physically distant zones, later returning to areas that have already been visited. These situations may occur, for example, when an operator is in a central zone and needs to move to an area located at one end of the warehouse to collect an item, subsequently returning to the central zone to continue the route.

This type of route may result in additional movements and an increase in the time required to complete the picking routes, highlighting potential opportunities for improvement in the organisation of picking routes within the warehouse.

Before conducting the measurement and monitoring of the picking routes associated with specific services, with the aim of assessing optimization opportunities, a preliminary intervention was performed at the level of space organisation in the clinical warehouse, particularly in the Specific and General zones. This intervention aimed to improve the use of the available space, reorganize the arrangement of certain items, and reduce the concentration of products in areas with higher storage density. The reorganisation of these zones created better conditions for the analysis of picking routes and for the subsequent evaluation of the impact of potential changes on the efficiency of warehouse logistics operations.

4.1.3.2 Optimization of the Specific and General Zones

For this analysis, data related to picking operations were collected using the Data Discovery software, considering the period between January 1, 2024, and March 9, 2026. These data are exported to a specific Excel file, which is subsequently integrated into Power BI, with the information being obtained directly from the Glintt system database.

Based on these data, it was possible to analyse the picking frequency of the different items stored in the warehouse, allowing the identification of zones with higher activity and products with different turnover levels. To support this analysis, a decision-support dashboard was used, enabling the visualization of picking data by item, zone, and time (Figure 12 and Figure 13).



Figure 12 - Dashboard used to analyse warehouse picking operations, including indicators of consumption, picking lines, and distribution by storage zones



Figure 13 - Analysis of picking operations by storage zone and specific warehouse location

During this analysis, it was identified that the Specific zone presented a high concentration of items and a significant level of picking activity. During the analysed period, this zone recorded 662 days with picking operations, indicating that it is an area frequently visited by operators during picking routes.

In addition to the high frequency of use, it was also observed that comparable products were stored close to each other in this zone, which could increase the likelihood of errors during the material picking process.

In response to this situation, an intervention was proposed with the objective of reducing the overload in the Specific zone by transferring some low-turnover items to other areas of the warehouse.

In the first stage, the warehouse coordinator identified an initial set of 25 items located in the Specific zone that presented lower turnover or were not integrated into the Kaizen routes, being frequently requested through electronic orders placed directly by the services (Annex 1).

Although some of these items were present in supermarkets and had RFID tags, they showed a low picking frequency, which justified their analysis for relocation.

Subsequently, a detailed analysis of these items was carried out based on different criteria, namely the number of picking days associated with each item, the volume of the stored boxes, the XYZ classification of products, in which X items present high turnover, Y items intermediate turnover, and Z items low turnover, and the presence of the items within

the hospital supermarkets. The resulting XYZ classification for the items analysed in the Specific and General zones is presented in Table 4.

Table 4 - XYZ classification of the items analysed in the Specific and General zones

	Specific zone	**General zone**
Total Items	25	15
X Classification	-	2
Y Classification	4	5
Z Classification	21	8
% X	-	13%
% Y	16%	33%
% Z	84%	53%
% Total	100%	100%

It was observed that more than 80% of the items analysed were classified as Z, indicating low turnover and a reduced number of picking operations associated with these products.

Items classified as Z should not be considered stockable. However, factors such as minimum order quantities imposed by suppliers or the existence of stock that still needs to be consumed mean that, in practice, these items must be maintained as stockable in the warehouse.

Based on this analysis, 11 items were selected to be relocated to other warehouse zones, considering products with a lower number of picking days, larger box volume, and lower presence in the hospital supermarkets.

This decision made it possible to free up space in the Specific zone, keeping in this area only the products with higher consumption frequency.

To accommodate the items removed from the Specific zone, available shelves in the General zone that were underutilized were used.

These shelves are in an area behind the trucks used in the Kaizen routes, which is a zone with lower accessibility for operators during picking routes. Therefore, this location proved to be suitable for storing low-turnover products.

After analysing the same criteria for the General zone, picking days, XYZ classification, box volume, and presence in supermarkets, six items were selected to be removed from this zone (Annex 2).

The results show that more than half of the analysed items were classified as Z, reinforcing the presence of low-turnover products in this zone. However, although the relocation of two items classified as X was suggested, it was decided not to proceed with this change due to the high number of picking operations associated with these items.

The reorganisation of the Specific and General zones not only made it possible to free up space in the previously overloaded area but also allowed the reuse of locations within the location tree that were not being used (Appendices 1).

During this intervention, several actions were conducted, including the relocation of low-turnover items to less frequently accessed zones, the reorganisation of shelves to maximize the use of available space, and the separation of equivalent products. These measures help reduce the risk of picking errors and free up shelves for the potential storage of new stockable items.

It is important to note that changes in product locations also require the update of several operational elements, such as kanban, location identification on supermarket boxes, and operators' adaptation to the new product locations in the warehouse. However, since most of the relocated items had low turnover and limited presence in supermarkets, the impact of these changes on daily operations was considered minimal.

Figure 14 shows the warehouse layout, highlighting the zones analysed during this intervention.

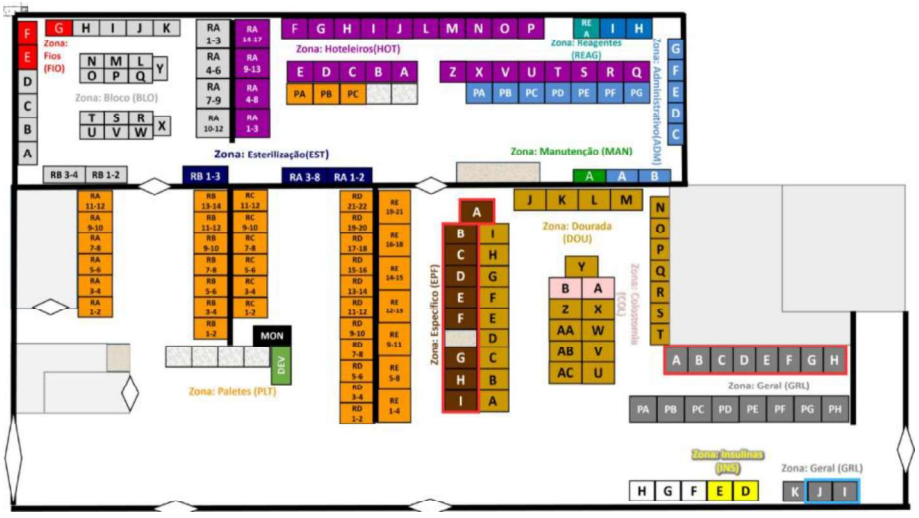


Figure 14 - Warehouse layout highlighting the zones analysed during the space optimization intervention

The areas marked in red correspond to the zones where low-turnover items were identified and removed, while the area marked in blue represents the shelves used to store the relocated products.

4.1.3.3 Initial Operation Measurement

Before implementing changes to the picking routes, an analysis of the operation, considering both time and distance, was conducted in its initial state, with the objective of understanding the performance of the existing routes and subsequently assessing the impact of potential improvements. For this purpose, four samples were collected, corresponding to different services.

During the monitoring of these routes, it was also possible to observe the paths followed by the operators within the warehouse. In some cases, it was noted that operators needed to return to the same corridor more than once during the same route. This situation results from the sequence defined in the route, which may require operators to move between different warehouse zones and later return to areas that had already been covered.

The measurements allowed for an initial characterization of the operational flow and the identification of potential opportunities for improving the organisation of the picking routes.

However, it is important to note that the time measurements may be influenced by several operational factors, such as:

- The operators responsible for different services change on a weekly basis.
- The number of items included in each route.
- The volumetric size of the products.

To complement the temporal analysis, the distance travelled between items was also measured using a smartwatch, through which it was possible to count the number of steps in each sampling. For analysis purposes, the equivalence of 1 step = 1 metre was considered, considering the sequence defined by the existing route in the system. This approach made it possible to evaluate the route travelled by the operators independently of the variations associated with execution time.

The measurements obtained are presented in Table 5.

Table 5 - Performance indicators of the picking routes analysed in the initial state of the warehouse

Sample	Total Time	Average Time per Item	Zones	Average Time per Zone	Distance (metres)	Average Distance per Item	Efficiency	Average Speed
1	00:11:49	00:00:39	4	00:02:57	90	5,00	0,20	7,61
2	00:14:01	00:00:34	4	00:03:30	148	5,92	0,17	10,56
3	00:05:07	00:00:31	3	00:01:42	86	8,60	0,12	16,80
4	00:24:44	00:00:42	6	00:04:07	196	5,60	0,18	7,93

Each sample corresponded to a picking route associated with a specific service:

- Sample 1 – Urology L Service, with 18 items (Appendices 2)
- Sample 2 – Medicine E Service, with 25 items (Appendices 3)
- Sample 3 – Medicine F Service, with 10 items (Appendices 4)
- Sample 4 – Ambulatory Surgery Service, with 35 items (Appendices 5)

The analysis of the results shows that the average time per item varies between 31 and 42 seconds, reflecting differences between the analysed routes that may be related to the number of zones covered, the arrangement of products within the warehouse, and the characteristics of the items.

Regarding the distance travelled, the values observed across the different routes range from approximately 86 metres to 196 metres, depending on the number of items included in each route and their location within the warehouse. These values demonstrate that the distance travelled during the picking process may vary significantly according to the requested items and the sequence defined by the route.

To complement the analysis, additional indicators were also calculated: average distance per item, efficiency, and average speed. The average distance per item allows the evaluation of product dispersion within the warehouse, while efficiency represents the relationship between the number of items collected and the distance travelled, with higher values indicating greater route efficiency. In turn, average speed makes it possible to understand the relationship between route execution time and the distance travelled by operators, with higher values indicating faster route execution. However, this indicator may be influenced by factors such as total distance travelled, number of items, and operational conditions, and therefore does not exclusively reflect operator performance, but also the characteristics of the route and the operation itself.

The values obtained reveal variations among the analysed routes. These differences may be related to the arrangement of products within the warehouse and the zones covered on each route, indicating the existence of less efficient paths and potential opportunities for improvement in the organisation of picking routes.

In addition to these measurements, the total distance associated with the initial route defined by the complete warehouse location tree was also calculated, corresponding to approximately 418 metres. This measurement made it possible to understand the maximum potential route that may be travelled when the picking sequence fully follows the order defined in the system.

Thus, the obtained results establish a reference for the performance of the picking routes in their initial state, which will subsequently be used to evaluate the impact of the proposed changes on the efficiency of logistics operations.

4.1.3.4 Assessment of operators' needs and suggestions

After analysing the four picking routes performed, the opinions of the operators who regularly conduct these operations were collected. For this purpose, five operators were consulted and asked to indicate the most appropriate starting point for the picking route and the sequence of zones they considered most efficient until the end of the route.

Based on the suggestions gathered and the operators' practical experience in performing these tasks, it was possible to identify a route sequence considered more suitable for conducting the picking routes. Based on this information, a new route order was then defined, allowing the design of a new route aimed at reducing unnecessary movements and making the path more efficient.

4.1.3.5 Proposed changes to the picking route

Before designing a new picking route, a decision was made to eliminate the Insulin zone previously existing in the clinical warehouse. The shelves in this area were incorporated into the General zone, remaining available for future use if it becomes necessary to store new products.

The items that were previously located in the Insulins zone were transferred to the Monos zone, as they are currently undergoing discontinuation within the warehouse, and will henceforth be supplied through community pharmacies following the termination of the state distribution program for these materials.

Following this physical reorganisation of the warehouse, a new picking route was designed with the aim of reducing unnecessary movements and avoiding repeated passes through the same corridors. The new route was defined to start in the General zone, then follow a structured path from the right to the left side of the warehouse, passing through the Block zone and ending in the Reagents area. Figure 15 presents the new picking sequence.

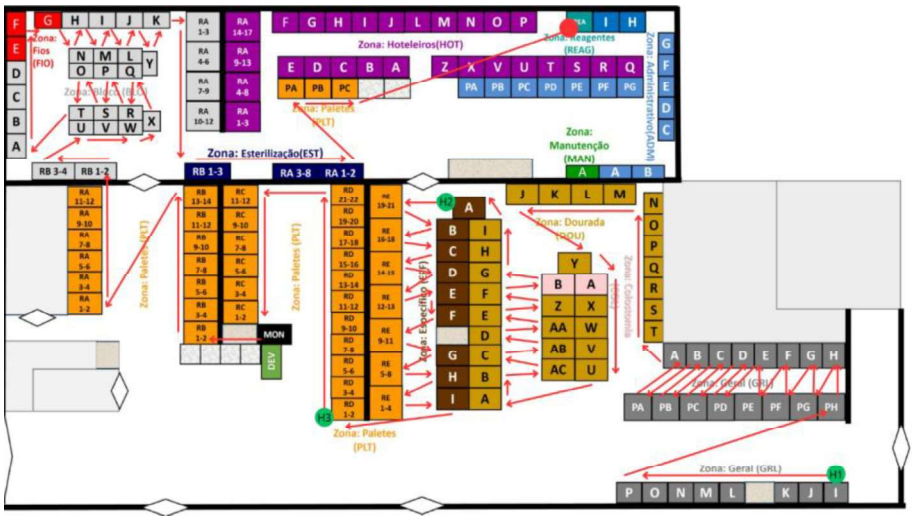


Figure 15 - Proposed reorganisation of the picking route in the warehouse, highlighting the suggested sequence for item collection

Additionally, the concept of cross-aisle picking was introduced in adjacent corridors, allowing operators to collect items from two nearby corridors in a single pass. This approach aims to reduce the need to return to the same corridor during a picking route associated with a specific service.

During the process of defining this new route, some operators indicated that, for certain services, it might be more efficient to start the picking process in the zone where larger-volume items are located, as these items may affect the available space in the transport cart.

Considering these suggestions, three possible starting points for the picking routes were defined:

- First starting point (H1): Shelving Unit I, shelf 1, General zone (Appendices 6)
- Second starting point (H2): Shelving Unit A, shelf 0, Specific zone (Appendices 7)
- Third starting point (H3): Rack RD 1 and 2, Pallets zone. (Appendices 8)

These starting points are identified for all operators, allowing each operator to choose the most appropriate one depending on the items included in the picking route.

Thus, when operators choose to start picking in the Specific zone, the route tends to initially develop toward the left side of the warehouse, after which it becomes necessary to return to the Golden and General zones, located on the right side of the Specific zone. However, the exact path will always depend on the items included in each picking route.

4.1.3.6 Operations measurement after route modification

After defining the new picking route, an evaluation of its impact on warehouse operations was conducted.

In an initial phase, and to ensure comparability of results, it was decided to use the same samples previously analysed (Samples 1 to 4), keeping constant the number of items and execution times. Thus, only the distance travelled was updated, considering the new picking sequence defined by the proposed route. This approach made it possible to isolate the impact of route modification on the operators' travel path, eliminating the influence of operational variables such as the operator, product volumetry, or the number of items per route.

Based on this new distance, indicators such as average distance per item, efficiency, and average speed were recalculated, allowing a direct comparison with the results obtained in the initial state. The results obtained from this comparison are presented in Table 6.

Table 6 - Comparison of picking route performance indicators between the initial and updated routes

		Initial Route				Updated Route			
Sample	**Total Time**	**Distance (metres)**	**Average Distance per Item**	**Efficiency**	**Average Speed***	**Distance (metres)**	**Average Distance per Item**	**Efficiency**	**Average Speed***
1	00:11:49	90	5	0,2	7,61	60	3,33	0,3	5,08
2	00:14:01	148	5,92	0,17	10,56	104	4,16	0,24	7,42
3	00:05:07	86	8,6	0,12	16,8	73	7,3	0,14	14,26
4	00:24:44	196	5,6	0,18	7,93	111	3,17	0,32	4,49

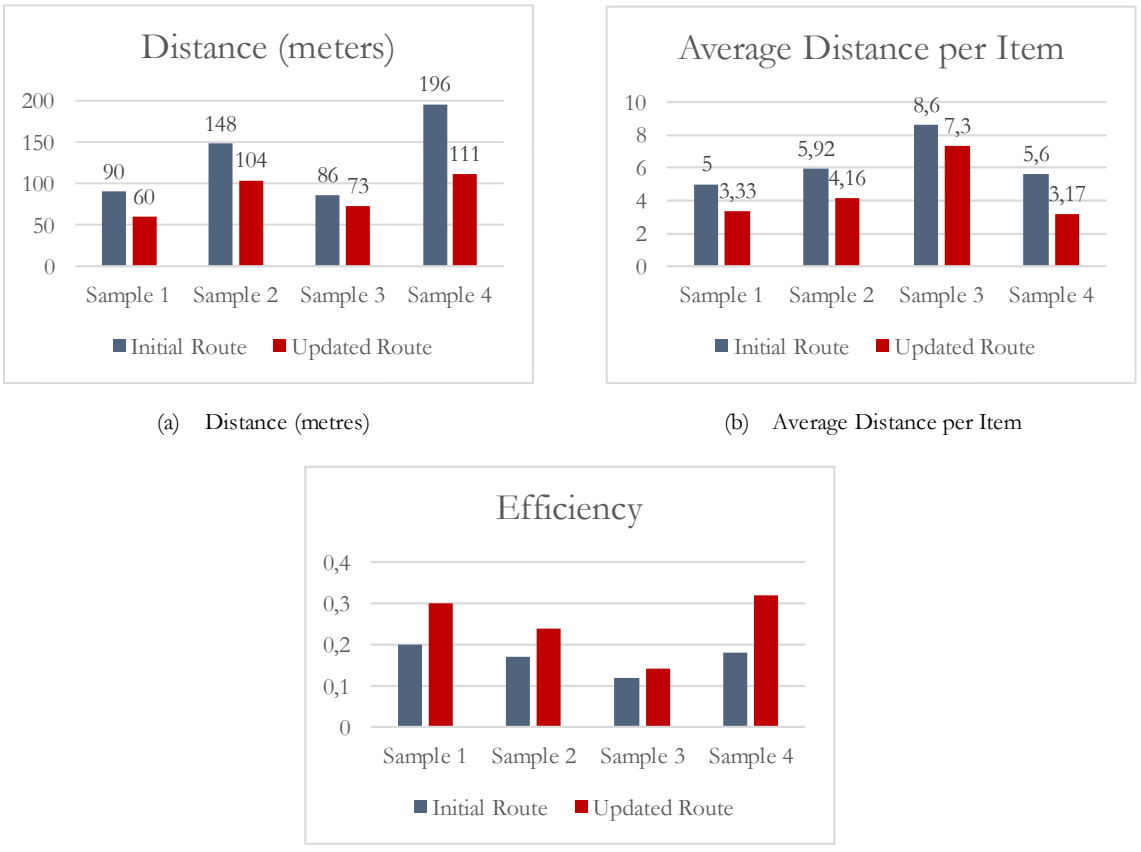
*Note. Execution time was kept constant between the initial and updated route scenarios. Consequently, changes in Average Speed result mechanically from changes in estimated distance and should not be interpreted as an improvement or deterioration in operational performance.

For this controlled comparison, the execution time and number of picked items were kept constant for each sample, while the distance was recalculated according to the updated route sequence. This approach was adopted to isolate the effect of the route sequence on the estimated travel distance and related indicators. To facilitate the interpretation of the results,

the analysed departments and the respective number of items per sample are presented again below:

- Sample 1 – Urology Department L, with 18 items (Appendices 9)
- Sample 2 – Medicine Department E, with 25 items (Appendices 10)
- Sample 3 – Medicine Department F, with 10 items (Appendices 11)
- Sample 4 – Ambulatory Surgery Department, with 35 items (Appendices 12)

To complement the analysis presented in Table 6, Figure 16 presents a graphical comparison of the main performance indicators.



(a) Distance (metres)

(b) Average Distance per Item

(c) Efficiency

Figure 16 - Comparison of the main performance indicators: (a) Distance travelled, (b) Average distance per item and (c) Efficiency

The analysis of the results indicates a consistent reduction in the distance travelled across all samples, with a significant decrease in the number of metres associated with the picking routes. This reduction is also reflected in a decrease in the average distance per item, indicating lower product dispersion throughout the route and an improvement in the organisation of the picking sequence.

Additionally, an increase in the efficiency indicator can be observed in all samples, reflecting a better relationship between the number of items collected and the distance travelled. These results indicate that the new route makes it possible to reduce unnecessary movements, eliminating redundant paths and contributing to greater overall efficiency in picking operations.

In addition to the analysis by sample, the total distance associated with the new picking route was also considered, corresponding to approximately 248 metres, allowing comparison with the total distance of the initial route and the evaluation of the potential reduction in travel distance throughout the entire sequence defined in the system.

It can be observed that the initial route presents a less optimized sequence, with possible redundant movements and the need to return to previously covered zones, whereas the updated route was structured in a more continuous and sequential manner. This reorganisation of the route resulted in a significant reduction in the total distance travelled, decreasing from approximately 418 metres to 248 metres, which highlights an improvement in route organisation and a reduction in unnecessary movements, thereby contributing to greater efficiency in picking operations.

In a second phase, and with the objective of validating the practical applicability of the new route, new measurements were conducted for the same departments, the results of which are presented in Table 7. This analysis made it possible to evaluate the behaviour of the route in a real operational context, considering different operational conditions, while also assessing whether the new picking sequence proved to be adequate and functional from the operators' perspective.

Table 7 - Performance Indicators of the Analysed Picking Routes after Updating the Picking Route

Sample	Total Time	Average Time per Item	Zones	Average Time per Zone	Distance (metres)	Average Distance per Item	Efficiency	Average Speed
A	00:34:41	00:01:07	5	00:06:56	123	3,97	0,25	8,77
B	00:11:08	00:00:56	3	00:03:43	56	4,67	0,21	10,94
C	00:30:30	00:01:10	3	00:10:10	84	3,23	0,31	3,40
D	00:42:38	00:00:51	6	00:07:06	97	1,94	0,52	8,21

Each sample corresponded to a picking route associated with a specific department:

- Sample A – Urology Department L, with 31 items. (Appendices 13)
- Sample B – Medicine Department E, with 12 items. (Appendices 14)

- Sample C – Medicine Department F, with 26 items. (Appendices 15)
- Sample D – Ambulatory Surgery Department, with 50 items. (Appendices 16)

The obtained results reveal variations in execution times, number of items, and number of zones covered, reflecting the dynamic nature of logistics operations. This variability results from factors such as operator rotation, product diversity, and the volume of the items included in each route.

Therefore, this second analysis is not directly comparable with the initial analysis, since variables such as the operator, the number of items, and product characteristics were not kept constant. Nevertheless, the analysis of the indicators still makes it possible to observe improvement trends, particularly in terms of the reduction in average distance per item and the increase in efficiency in some routes, highlighting a positive impact of the new route organisation.

Additionally, this phase made it possible to validate the new route in a real operational context, confirming that the proposed sequence is feasible, suited to operators' needs, and applicable to the daily warehouse operations.

Taken together, the two studies conducted allow the conclusion that the modification of the picking route contributes to the reduction of travel distances, improvement of route efficiency, and optimization of movement flow within the warehouse, while also being validated from an operational perspective.

4.1.3.7 Summary of the Picking Route Optimization

The analysis of the picking routes within the ULSM clinical warehouse revealed significant limitations associated with the sequence defined in the system, namely the existence of redundant paths, unnecessary movements, and the absence of continuous logic in route organisation. These inefficiencies reflect a misalignment between the structure parameterized in the system and the operational reality of the warehouse, negatively impacting the efficiency of picking operations.

The adopted methodology, based on the analysis of picking data, direct observation of operations, and the incorporation of operators' knowledge, proved fundamental for identifying improvement opportunities grounded in empirical evidence. This process made it possible not only to understand the limitations of the initial route, but also to support the proposal of a new sequence better suited to the real operational context.

The reorganisation of the warehouse space, particularly within the Specific and General zones, constituted a structural element for route optimization, highlighting the interdependence between layout and operational performance. The relocation of low-turnover items to less accessible areas contributed to reducing product dispersion and improving route flow.

The new picking route, defined according to sequential and continuous logic, enabled a significant reduction in the total distance travelled, decreasing from approximately 418 metres to 248 metres, which corresponds to a substantial reduction in the distance associated with operations. This reduction reflects not only an improvement in route organisation, but also the elimination of structural inefficiencies presents in the initial sequence. Additionally, the analysis of the indicators demonstrates a reduction in the average distance per item and an increase in efficiency, reinforcing the positive impact of the proposed solution.

However, it is important to emphasize that the performance evaluation presents certain limitations, namely the variability associated with operators, the number of items per route, and product volumetry, factors that condition the direct comparability of results in a real operational context. Furthermore, the parameterization of routes within the system requires continuous updating whenever layout modifications occur, which may compromise the sustainability of the improvements if a systematic review process is not implemented.

The introduction of multiple route starting points and the concept of cross-picking demonstrate a more flexible approach, adapted to operational variability, although it also implies greater dependence on operator decision-making, which may introduce some variability in execution.

In summary, the work conducted suggested that the optimization of picking routes should not be regarded as a static process, but rather as a dynamic activity requiring continuous alignment between layout, information systems, and operational practices. The adopted approach indicated clear gains in terms of operational efficiency and organisation, while also reinforcing the need for continuous monitoring and adaptation to the real conditions of the logistics system to ensure the sustainability of the implemented improvements.

4.1.4 Continuous Improvement and 5S Assessment

During the analysis and optimization of the picking routes, several inefficiencies related to space organisation, material identification, and the use of visual management

elements within the warehouse were identified. These observations, conducted through direct observation of operations during the internship period, highlighted improvement opportunities beyond the reorganisation of the routes themselves.

In this context, a visual analysis of the warehouse was conducted with the aim of evaluating space organisation, material accessibility, and the clarity of the information available to operators. This analysis made it possible to identify situations such as the absence of identification in some locations, lack of standardisation in material organisation, and limitations in terms of visual management.

Given the identified situations, the need to structure a more systematic approach to warehouse assessment was established. Therefore, an audit based on the 5S methodology was developed with the objective of supporting the implementation and maintenance of organisation, cleanliness, standardisation, and discipline practices.

For this purpose, an audit tool (digital form) was developed, enabling the evaluation of different warehouse areas at both administrative and operational levels, ensuring a consistent approach to the identification of improvement opportunities.

4.1.4.1 Visual Analysis of the Warehouse

The visual analysis of the warehouse was conducted through direct observation of logistics operations during the internship period, allowing the evaluation of space organisation, material identification, and the use of visual management elements.

In general, it was observed that the warehouse presents a set of good practices in terms of visual management, contributing to space organisation and operational efficiency. These include the identification of zones, racks, and locations, as well as the presence of maps and indexes in each zone, where items and their respective locations are listed, as shown in Appendices 17. These elements facilitate operators' orientation and support the picking process.

Additionally, it was observed that the items are identified in their respective locations, allowing a direct association between the product and its storage location.

Beyond the identification elements, the existence of visual support containing operational instructions was also observed, namely information boards with picking guidelines and instructions for distribution management. These elements contribute to the standardisation of operations and to the uniformity of the procedures adopted by operators.

The presence of this type of visual information plays a relevant role in reducing variability in task execution, facilitating the integration of new operators, and contributing to the reduction of errors during the picking process.

Despite these positive aspects, some situations that may affect operational efficiency were identified. It was observed that, in certain zones, some boxes are stored at considerable height close to the ceiling, which may restrict access to products and their identification during the picking process (Appendices 18).

In addition to this situation, other aspects related to space organisation and maintenance were also identified. In terms of cleanliness and conservation, it was observed that some racks presented an accumulation of dirt, which may compromise the visual organisation of the warehouse.

Regarding equipment supporting operations, such as ladders and waste bins, it was observed that not all of them were properly identified, making their rapid location, use, and subsequent storage more difficult.

Additionally, situations of deterioration of the floor marking were observed, namely in areas delimited by adhesive tape, as well as the existence of delimited spaces without clear identification of their function. These situations may reduce the effectiveness of visual management and hinder space organisation.

These observations indicate that, although the warehouse presents a structured basis of visual management, there are still opportunities for improvement in terms of accessibility and the standardisation of certain practices.

4.1.4.2 Implementation of Improvements in the Warehouse

Based on the visual analysis conducted, several actions were implemented with the objective of improving warehouse organisation, reinforcing material identification, and increasing the efficiency of logistics operations.

Regarding item identification, it was observed that, in some locations within the General zone, the labels were positioned outside the operators' direct field of vision during the picking process, making reading the PDA more difficult, as shown in Appendices 19.

To address this situation, suspended item identification was implemented, as shown in Appendices 20, allowing the information to be brought closer to the operator and facilitating reading during the execution of the picking route, thereby improving information accessibility and reducing the time required for item identification during the process.

In terms of space organisation, improvements were also implemented, including the reorganisation of certain areas, namely the Specific and General zones, as previously mentioned, contributing to a better visual presentation of the warehouse and to improved storage conditions.

Regarding equipment supporting operations, such as ladders and waste bins, identification labels were implemented, and specific storage locations were defined, facilitating their location, use, and organisation by operators, as illustrated in Figure 17.



Figure 17 - Some Improvements in the Identification of Equipment Supporting Operations

Regarding the floor markings, the existing areas were reinforced, namely through the renewal of zones where the adhesive tape showed signs of wear. This intervention made the organisation of the space more evident and improved the warehouse's visual management (Figure 18).

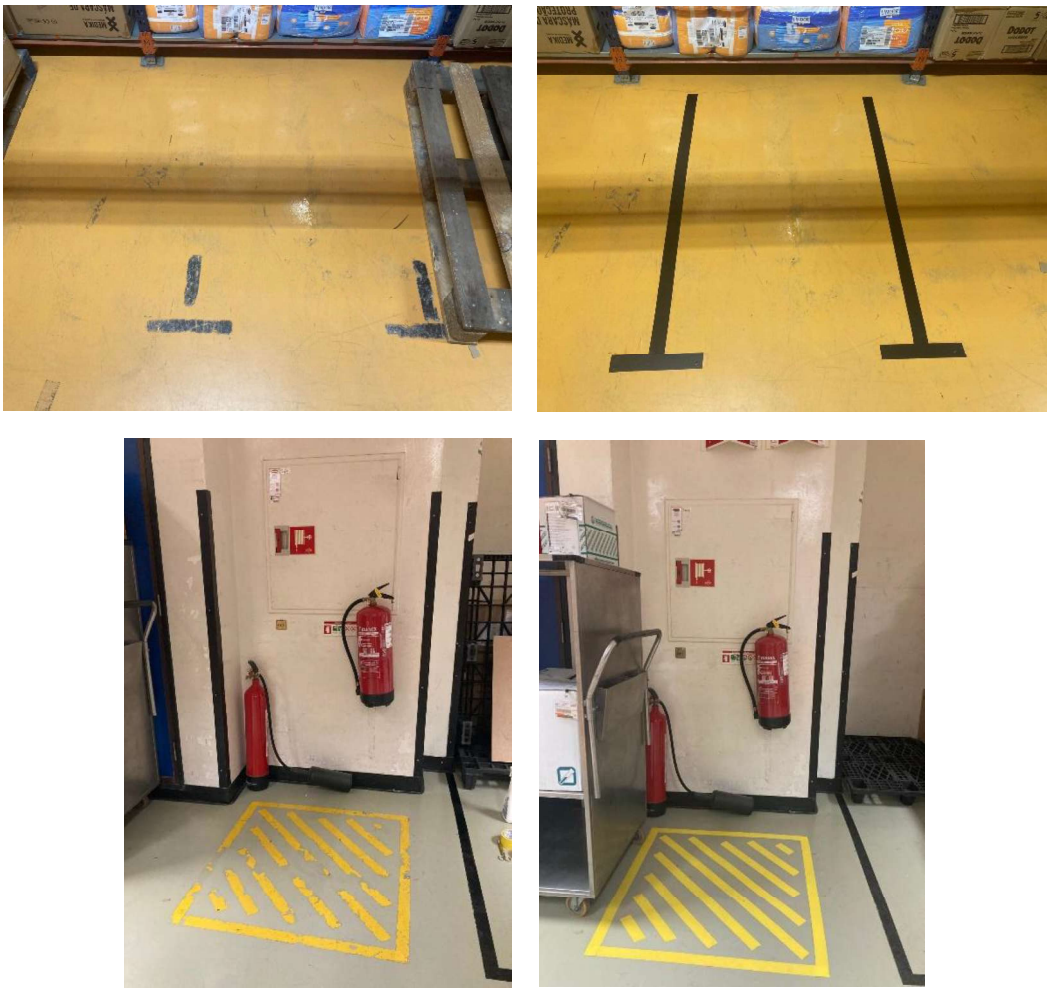


Figure 18 - Reinforcement of Floor Markings and Area Delimitation

Additionally, specific spaces within the warehouse were identified and marked through the placement of visual identification signs in the respective areas, namely zones associated with activities such as reception, preparation, and distribution, contributing to better operational organisation and to the reduction of ambiguities in the use of space.

Overall, the implemented improvements made it possible to reinforce warehouse organisation, improve the identification of materials and equipment, and contribute to greater efficiency and flow in logistics operations.

In addition to the physical improvements implemented in the warehouse, an awareness initiative regarding the 5S methodology was also conducted through the placement of explanatory visual support within the warehouse (Appendices 21). This initiative aimed to promote understanding of the principles associated with 5S and reinforce the importance of organisation, cleanliness, and standardisation prior to conducting the on-site audit.

Subsequently, the need to ensure the maintenance of the implemented improvements over time was identified, which led to the development of an audit based on the 5S methodology.

4.1.4.3 Development of a 5S Audit

Following the analyses conducted on warehouse operations and the improvements implemented in terms of organisation and visual management, a 5S-based audit was developed with the objective of systematically assessing the conditions of organisation, cleanliness, standardisation, and discipline across the different areas of the ULSM logistics system.

The purpose of creating this audit was not only to characterize the current state of the logistics spaces but also to ensure the continuity of the good practices that had been implemented, functioning as a monitoring and continuous improvement tool. In this context, its systematic application allows the reinforcement of operational consistency and promotes a more organized, efficient, and visually structured working environment.

To operationalize this assessment, a 5S audit form was designed and made applicable to the various areas of the LS. This instrument aims to identify deviations and improvement opportunities related to space organisation, material identification, cleanliness conditions, standardisation of procedures, and compliance with established standards, thereby contributing to improved visual management and logistics performance.

The assessment is conducted using a scale from 0 to 10, reflecting the degree of compliance observed for each criterion. This approach enables a quantitative evaluation of the performance of the different areas, facilitating comparisons between spaces and the monitoring of progress over time.

At the time of the audit, the evaluator must first select the area to be assessed from the following options: Open Space – Logistics, Aquarium, Transport/Distribution, Electronic Requests, Warehouse, Clinical Reception and Verification, and Pharmacy Reception and Verification.

The structure of the audit form is organized according to the five principles of the 5S methodology, enabling a comprehensive assessment of the different dimensions of the working environment:

- Seiri (Sort): assessment of the necessity of the materials present, identifying unnecessary items.

- Seiton (Set in Order): assessment of the organisation and arrangement of materials, as well as ease of access and identification.
- Seiso (Shine): assessment of cleanliness conditions and identification of sources of disorder or dirt.
- Seiketsu (Standardize): assessment of the existence of standards and standardized practices that ensure the maintenance of organisation and cleanliness levels.
- Shitsuke (Sustain/Discipline): assessment of compliance with established rules and the level of employee commitment.

The complete 5S audit model is presented in Appendices 22.

To ensure that the assessment is appropriate for the distinct types of spaces, the audit was structured into two complementary components:

- **Administrative component**, applied to administrative workspaces, where aspects such as organisation and accumulation of materials, document identification, cleanliness and organisation of workstations, condition of computer equipment, and the existence of defined procedures for the activities performed are assessed.
- **Operational component** (warehouse), applied to the physical warehouse environment, where aspects such as the presence of unnecessary materials, materials stored outside their designated locations, identification of items and storage locations, signage of zones and shelves supporting picking routes, clarity of floor markings, cleanliness conditions, warehouse accessibility and circulation, and the correct application of the Kanban system are assessed.

Therefore, the 5S audit constitutes a structured tool for assessment and continuous monitoring, enabling a systematic analysis of the organisational and operational conditions of the LS. Its application contributes to the consolidation of practices aligned with continuous improvement principles and to the strengthening of logistics process efficiency.

4.1.4.4 Pilot Application for the 5S Audit

To validate the audit tool developed, three pilot 5S audits were conducted in different areas of the Logistics Service. The audits were carried out by different employees, allowing the collection of distinct perspectives regarding the level of organisation, cleanliness, standardisation, and discipline within the evaluated areas.

Due to the proximity of the end of the internship period, it was not possible to conduct a larger number of audits. Therefore, the results presented should be considered as an initial application of the developed tool, with the primary objective of assessing its applicability and its ability to identify opportunities for improvement.

The audits were conducted in the Warehouse (Golden and Colostomy Zones), Pharmacy Receiving Area, and Aquarium Area. Table 8 presents the overall ratings assigned during the audits.

Table 8 - Results of the pilot application of the 5S Audit

Audit	Area Evaluated	Overall Rating
1	Warehouse Area (Golden and Colostomy Zones)	6
2	Pharmacy Receiving Area	7
3	Aquarium Area	6

The results obtained ranged between 6 and 7 points on a 10-point scale, indicating a reasonable level of compliance with 5S principles while highlighting several opportunities for improvement. The audits identified strengths related to product identification, visual management, and workplace organisation, as well as improvement opportunities regarding cleanliness, standardisation, and the elimination of unnecessary materials.

Overall, the pilot audits indicated that the developed tool is suitable for evaluating different areas of the Logistics Service and can support continuous improvement initiatives through the systematic identification of non-conformities and improvement opportunities. The completed pilot audits are presented in Appendices 23.

4.1.5 Internal Distribution Routes

In addition to the activities associated with the reception, storage, and preparation of materials, the ULSM LS is also responsible for the internal distribution of products to the different hospital departments. This activity plays a fundamental role in ensuring the continuous supply of clinical and operational units, guaranteeing that the necessary materials are available at the point of use at the appropriate time.

In this context, it is important to analyse the structure and operation of the internal distribution routes, as well as the factors that influence their organisation and daily execution.

4.1.5.1 Characterization and Operational Structure of the Internal Distribution System

The internal distribution system of the ULSM LS is responsible for the transportation and delivery of materials required by the different hospital departments, ensuring the supply of both clinical and operational units. The distribution process begins with electronic requests submitted by the various hospital departments according to their consumption and replenishment needs. These requests are subsequently processed and prepared by the LS, enabling the organisation of the load corresponding to each distribution route.

Internal distribution is organized through scheduled routes, defined according to the different hospital floors and functional areas, with specific departure times (ETD – Estimated Time of Departure) assigned to each route. This organisation structures the distribution flow throughout the day, ensuring the regular supply of the different hospital departments.

The routes currently scheduled are organized as follows:

- Logistics Route – Floor 4 (Morning) – ETD: 08:30
- Logistics Route – Floor 3 (Morning) – ETD: 09:00
- Logistics Route – Floor 2 (Morning) – ETD: 09:30
- Logistics Route – Floor 1 (Morning) – ETD: 10:00
- Logistics Route – Floor -1 (Morning) – ETD: 10:30
- Logistics Route – Floor 0 (Morning) – ETD: 11:00
- Logistics Route – MFR/GASTRO/OT/UCA – ETD: 14:00
- Logistics Route – Floor -1 (Afternoon) – ETD: 14:00
- Logistics Route – Floor 0 (Afternoon) – ETD: 14:00
- Logistics Route – Floors 1 and 2 (Afternoon) – ETD: 14:30
- Logistics Route – Floors 3 and 4 (Afternoon) – ETD: 15:00

It can be observed that, during the morning period, distribution routes are organized individually by floor, allowing each distribution to be conducted independently and associated with a single functional area of the hospital. However, during the afternoon period, due to the reduced time available for conducting distributions, some routes were combined to include two floors simultaneously, ensuring that deliveries can be completed within the available operational period.

Despite the current organisation, it is observed that two employees are usually assigned to internal distribution routes during the afternoon period. Therefore, the future separation of routes by floor, like the morning arrangement, may be considered. Such a reorganisation would allow the two employees to perform separate distributions simultaneously while maintaining the same departure times. Additionally, in situations where only one employee is available, it would still be operationally feasible to conduct two routes within the same time slot through the sequential execution of the corresponding distributions.

Each route is composed of different stops, corresponding to the hospital departments or areas where material deliveries are made. In turn, each stop may include several customers, corresponding to different specialties, units, or services located within the same hospital area. For example, a stop associated with Operating Block may include different customers, such as Orthopedics and Anesthesia.

Regarding the operational structure of distribution activities, requests may be classified into different service types, namely Order Fulfilment, Material Consumption, and Direct Reception. Each service is associated with a specific number of items or volumes, corresponding to the physical quantity of materials transported to each customer. Consequently, a single service may include multiple volumes, increasing the operational workload associated with distribution.

After the preparation of the load corresponding to each route, an LS employee conducts the physical distribution of materials to the different hospital departments included in the scheduled route.

4.1.5.2 Operational Variability of Distribution Routes

Despite the existence of pre-scheduled routes associated with specific departure times, the internal distribution operation exhibits an important level of operational variability. This variability results from the dynamic nature of the electronic requests submitted daily by the different hospital departments, directly influencing the composition and complexity of each distribution.

The number of departments included in each route may vary from day to day, as may the number of customers associated with each stop and the number of volumes transported. Consequently, even when two distributions belong to the same scheduled route, the associated operational workload may differ significantly, influencing the total distribution time, the physical effort required, and the complexity of the route performed.

In addition to the variability associated with requests, the practical execution of the routes also depends on the operational decisions of the employee responsible for the distribution. Although each route is associated with specific hospital floors or functional areas, the actual sequence of stops is not fully defined and may be adapted by the operator according to factors such as the number of volumes transported, service priorities, accessibility, and route organisation.

In this context, the internal distribution system can be characterized as semi-dynamic, as it combines both fixed and variable components. Scheduled routes, departure times, and the associated hospital areas remain predefined. However, the operational composition of each distribution varies continuously according to the daily requirements of the hospital departments.

It is also noteworthy that there is no predefined sequence of stops within each route. As a result, route organisation frequently depends on the operational decisions of the employee responsible for the distribution. This situation may lead to different approaches to organizing the loading of logistics trolleys and to inconsistent routes across distributions belonging to the same scheduled route.

4.1.5.3 Organisation and Sequencing Distribution Stops

With the aim of promoting greater operational standardisation of internal distribution routes, an analysis of the stops associated with each floor was conducted to define a logical delivery sequence to be followed by operators during distribution activities.

To define the sequence of stops, Zetes Chronos was used, the platform through which all delivery rounds that generate the daily routes are created and parameterized, according to the dispatches issued by Supermarket, a platform connected to the SGICM through which requests are received and fulfilled. By analysing the stops previously configured in the system, it was possible to identify the different delivery points associated with each floor and their respective routes.

At the same time, direct observation of employees during the execution of daily distributions was conducted, allowing the analysis of the routes followed and a better understanding of the operational organisation of deliveries.

Based on the information collected from ZetesChronos, the direct observation of distribution routes, and the analysis of the hospital floor plans, a proposed sequencing of

stops was developed, considering the proximity between departments, the location of lifts, and the logical continuity of the distribution route.

The definition of a stop sequence also enables a more efficient approach to the loading of logistics trolleys, allowing materials to be organized according to the planned delivery order and facilitating the distribution process conducted by operators.

4.1.5.4 Proposed Sequencing of Distribution Routes

The proposed sequencing of distribution routes was developed with the aim of promoting greater organisation and operational standardisation of the routes performed within the hospital's internal distribution system, while simultaneously reducing unnecessary movements during the material delivery process.

The definition of the stop sequence was based on an analysis of the physical layout of the different hospital floors, considering the main circulation corridor, the adjacent wings, and the lifts most used by employees during distribution activities. In this way, continuous and sequential routes were established, minimizing backtracking and interruptions throughout the operators' journeys.

For Floors -1 to 3, the starting point of the route was defined as the lift located closest to the Logistics Department, identified by employees as the lift most frequently used during distribution activities. Regarding Floor 4, the starting point was defined as the lift restricted to authorized personnel, as the lift normally used by the Logistics Department does not provide direct access to this floor.

The sequential organisation of stops was developed according to the physical arrangement of the different hospital departments, seeking to ensure route continuity along the main corridors and their respective wings. Whenever areas adjacent to the main corridor existed, they were immediately incorporated into the route, avoiding redundant movements and promoting greater operational flow.

It should be noted that the definition of the stop sequence was based exclusively on criteria related to the spatial organisation of the different hospital floors, without considering the operational priority of the departments. This approach is justified by the dynamic nature of the electronic requests issued daily by the various hospital units, meaning that some distributions may not include certain stops within the corresponding route. In this context, the proposed sequence is intended to serve as an organisational reference for operators, promoting greater consistency in route execution and delivery organisation.

In addition to the optimization associated with the distribution route itself, the definition of a structured sequence of stops also enables a more efficient approach to loading logistics trolleys, allowing materials to be organized according to the planned delivery order and facilitating access to the different volumes throughout the distribution process.

The proposed sequences for the different distribution routes are presented in Appendices 24 of this report, together with the hospital floor plans used as the basis for route definition.

4.1.5.5 Summary of the Internal Distribution Analysis

The analysis of the internal distribution routes provided a comprehensive understanding of the operational complexity associated with supplying the different hospital departments. It was observed that the daily dynamics of electronic requests directly influence the composition of distributions and the organisation of the routes conducted by employees.

Throughout the work developed, it was possible to identify the absence of a structured sequence of stops within the different distribution routes, a situation that generated variability in both route organisation and the loading of logistics trolleys. In response, a proposal for the sequence of stops was developed, based on the physical layout of the different hospital floors and the logical continuity of the routes performed.

In addition to improving route organisation, the definition of a structured stop sequence also enabled a more efficient approach to loading logistics trolleys, facilitating the organisation of materials according to the planned delivery order and improving access to the different volumes throughout the distribution process.

Beyond route reorganisation, several operational constraints associated with the internal distribution process were also identified. During the observation of distribution activities, it was noted that between 07:00 and 09:00 the lift most used by the LS experiences an important level of utilization due to various hospital activities, namely the distribution of meals to patients by the catering service, patient transportation, and deliveries associated with the Kaizen route. This situation may result in waiting times and reduced operational flow for logistics distributions.

In this context, adjusting the departure time of the Floor 4 Logistics Route, currently scheduled for 08:30, to 09:00 could contribute to better management of the operational flow associated with internal distributions. However, such a change would also require the rescheduling of the subsequent routes.

It was also observed that some afternoon routes simultaneously cover more than one hospital floor, significantly increasing the operational complexity associated with the routes performed by employees. In addition to increasing travel distances, this arrangement may hinder load management, delivery sequencing, and the overall efficiency of the distribution process.

Therefore, the future separation of afternoon routes by hospital floor could be considered, enabling a more organized and structured distribution process. Such a change could also facilitate the simultaneous execution of distributions by different employees whenever operationally justified, contributing to greater operational flexibility and a better adaptation to the daily variability of electronic requests.

Overall, the work conducted made it possible to identify improvement opportunities related to route organisation, operational management of distributions, and the structuring of internal routes, contributing to greater standardisation and efficiency within the hospital logistics process.

5. Conclusion

The present internship aimed to analyse and improve the logistics performance of the ULSM through the optimization of warehouse layout and internal material flows. The study addressed warehouse operations, picking activities, internal distribution, visual management, and logistics performance indicators, with the objective of identifying operational inefficiencies and developing feasible improvement measures.

The analysis of warehouse operations identified opportunities for improvement in product positioning, space utilization, and organisation. The reorganisation of the Specific and General zones, supported by product turnover and picking frequency, enabled the relocation of 11 items from the Specific zone and the removal of 6 items from the General zone. These changes contributed to better use of available storage space, reduced product dispersion, and improved the organisation of picking activities.

The optimization of picking routes produced the most significant quantitative result of the study. The initial route presented redundant movements and repeated passages through the same areas. Based on operational data, direct observation, and input from warehouse operators, a new picking sequence was developed. Under controlled conditions, the total route distance was reduced from approximately 418 m to 248 m, corresponding to a reduction of approximately 40.7%. Average distance per item also decreased, while efficiency increased, indicating a more compact picking sequence. However, these results should be interpreted as the outcome of a controlled route-sequence assessment rather than as direct evidence of an operational before-and-after improvement.

The study also contributed to improving visual management and continuous improvement practices. Existing organisational practices were assessed through a 5S-based approach, and a structured audit tool was developed and piloted in three areas of the Logistics Service. The results, ranging from 6 to 7 out of 10, indicated a reasonable level of compliance while highlighting opportunities for improvement, particularly in cleanliness, standardisation, and organisation. Regarding internal distribution, structured stop sequences were proposed to improve route continuity and trolley organisation, although these measures could not be fully implemented and evaluated during the internship period.

Overall, the objectives defined for the internship were substantially achieved. The study provided a systematic analysis of logistics operations, identified concrete sources of inefficiency, implemented feasible improvements, and assessed their operational impact through quantitative and qualitative indicators. The results provide evidence that

improvements in warehouse organisation and picking route design can generate relevant operational benefits without requiring major structural changes.

Nevertheless, several methodological limitations should be acknowledged. First, travel distances were estimated based on the number of steps recorded during the picking operations, using the simplifying assumption of one meter per step. Second, in the controlled comparison between the initial and updated picking routes, execution time was kept constant to isolate the effect of the route sequence, which limits the interpretation of time-related performance. The analysis was also based on a limited number of picking samples, while the pilot application of the 5S audit was restricted to three areas. Finally, some of the proposed improvement measures could not be implemented and/or operationally evaluated within the internship period. These limitations should be considered when interpreting the results and highlight the importance of further monitoring and validation under real operating conditions.

Future work should further validate the proposed changes through direct distance measurements and repeated operational observations following their implementation. Further research could also focus on continuously monitoring the implemented improvements, reassessing picking routes following layout modifications, expanding the application of the 5S audit, and evaluating the proposed internal distribution sequences under real operating conditions.

In conclusion, this study provides evidence that the combination of operational data, direct observation, employee involvement, and continuous improvement methodologies can provide an effective basis for optimising logistics processes in a healthcare environment. By improving the alignment between warehouse layout, operational practices, and digital logistics systems, the work developed during the internship contributes to more efficient, organized, and standardized logistics operations at ULSM.

6. Appendices

Appendices 1 – Optimization of the Specific and General Zones





Specific Zone before and after the space optimization process.





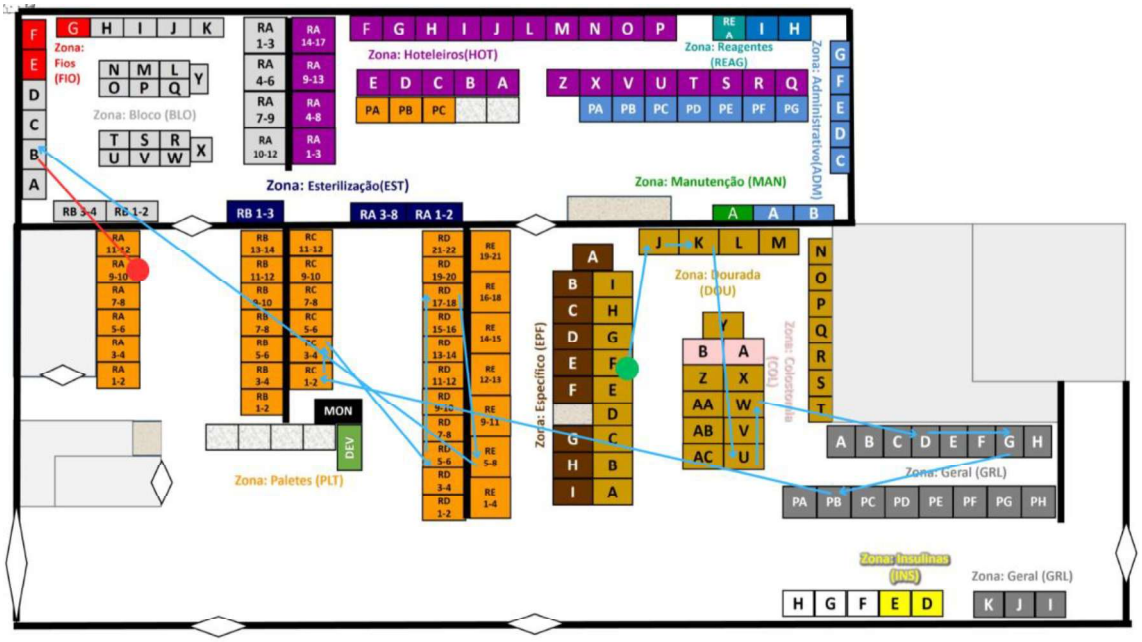
General Zone before and after the space optimization process.



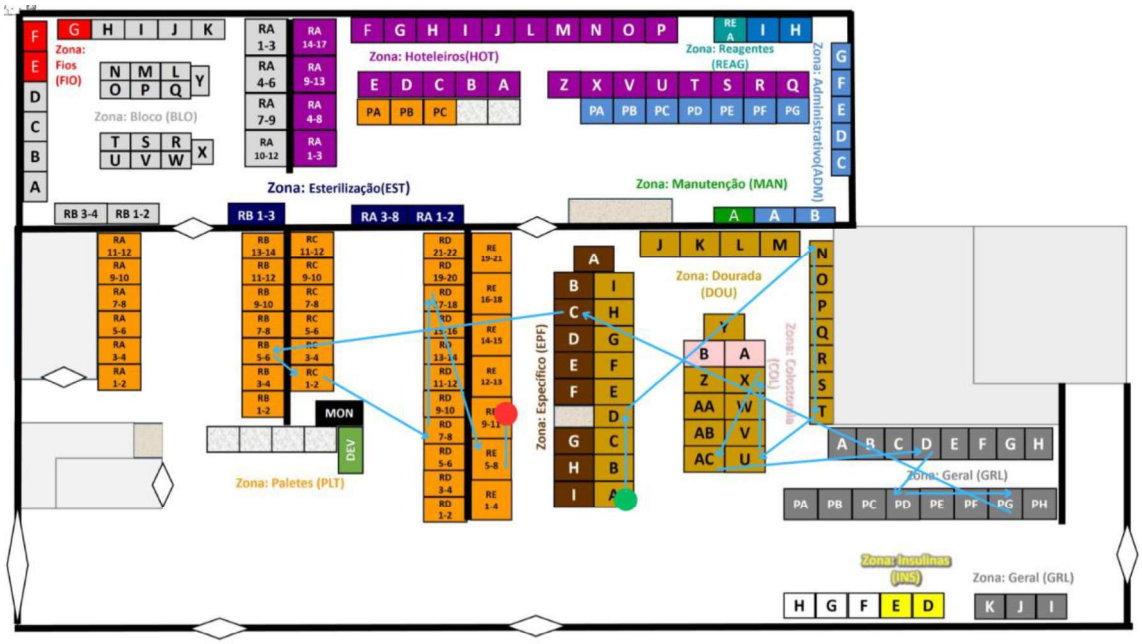


General Zone shelving units used to store the items removed during the optimization process.

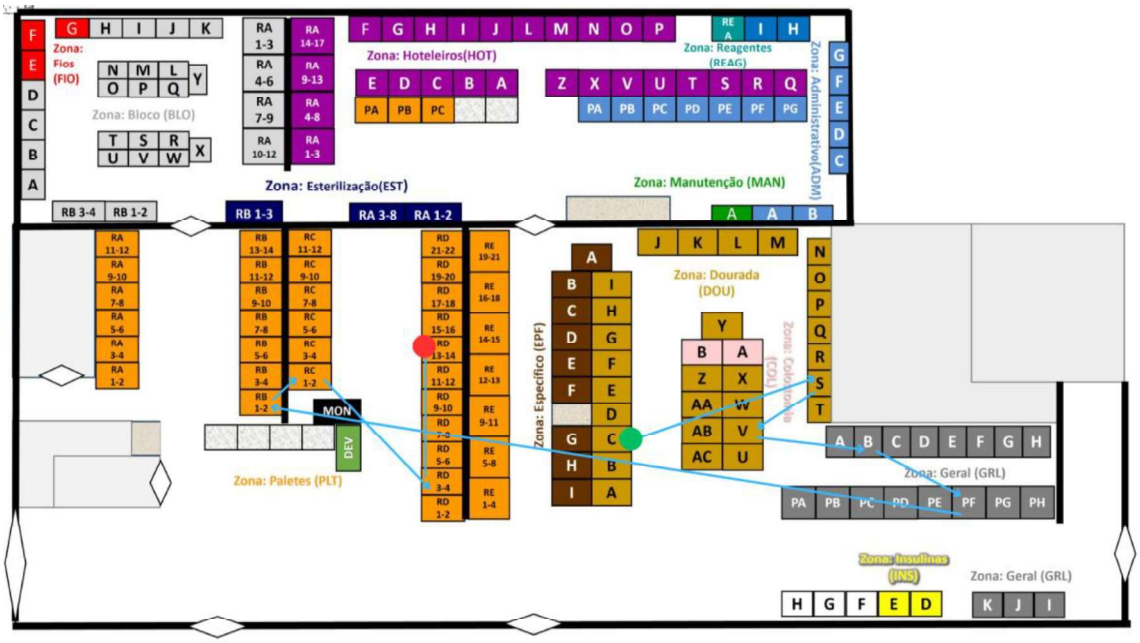
Appendices 2 – Analysis of Picking Routes in the Initial Warehouse Layout: Sample 1



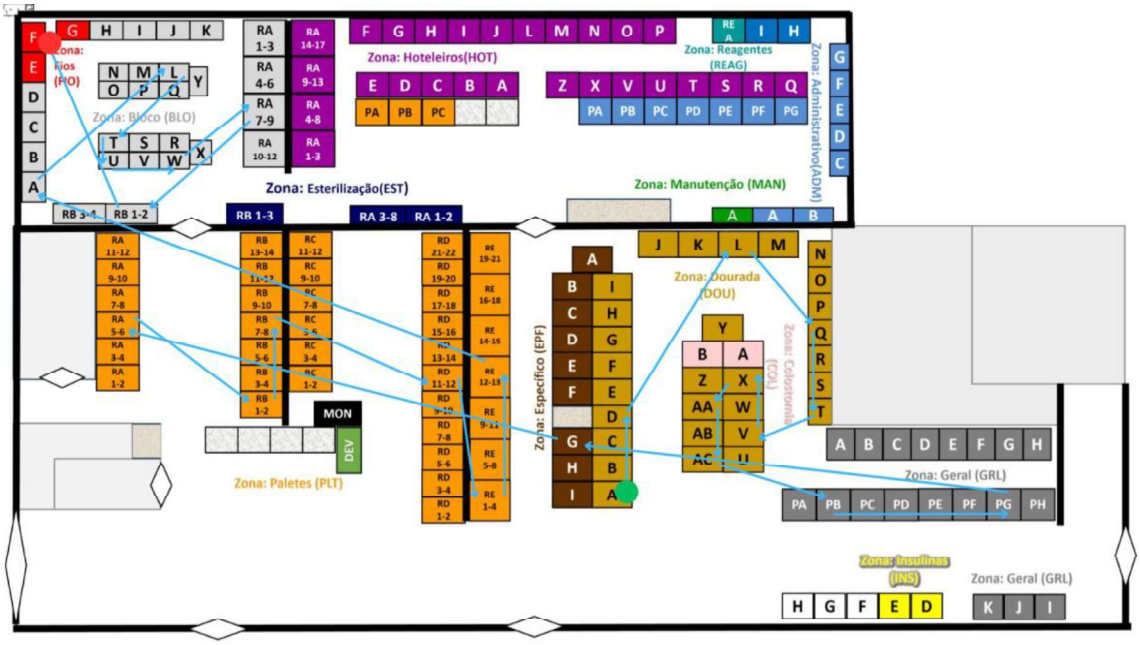
Appendices 3 - Analysis of Picking Routes in the Initial Warehouse Layout: Sample 2



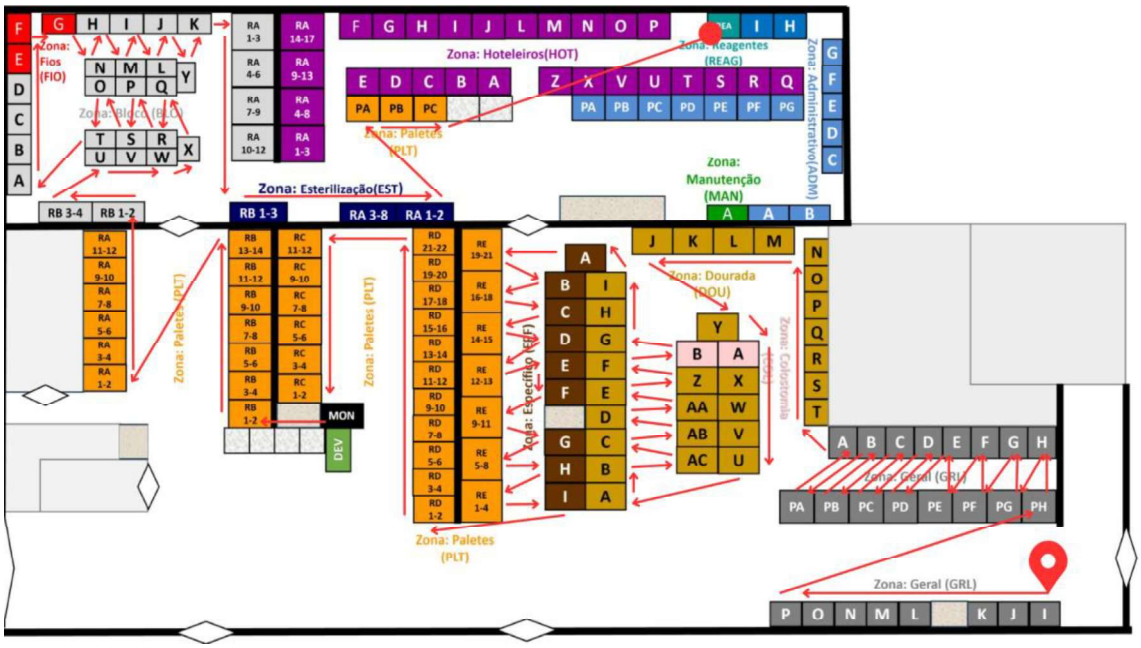
Appendices 4 - Analysis of Picking Routes in the Initial Warehouse Layout: Sample 3



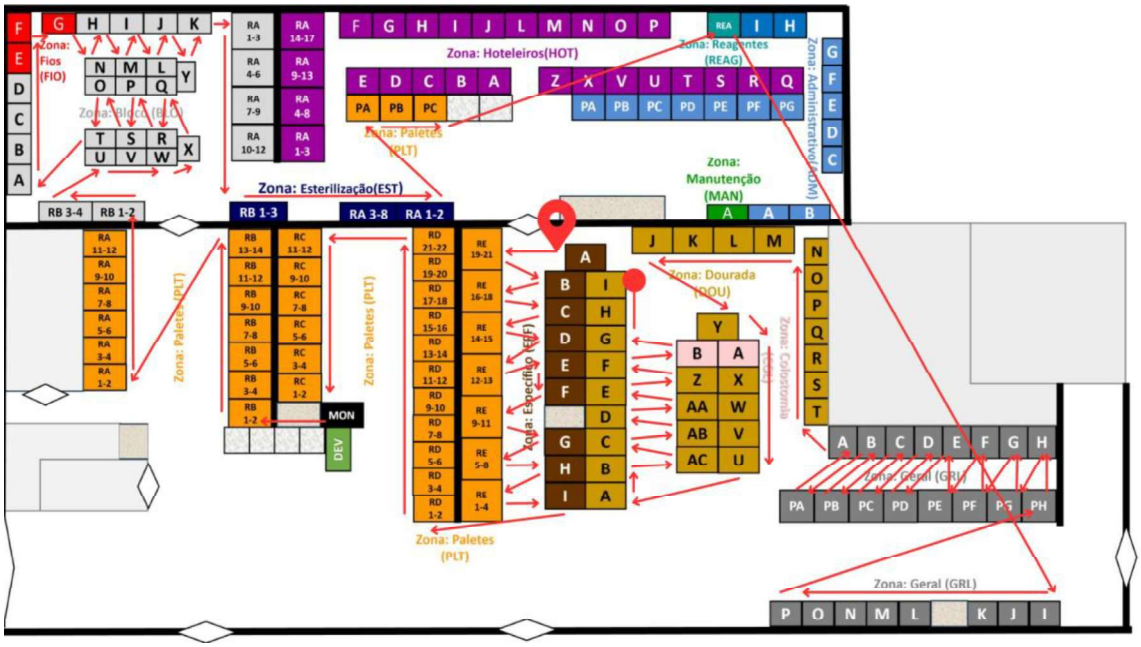
Appendices 5 - Analysis of Picking Routes in the Initial Warehouse Layout: Sample 4



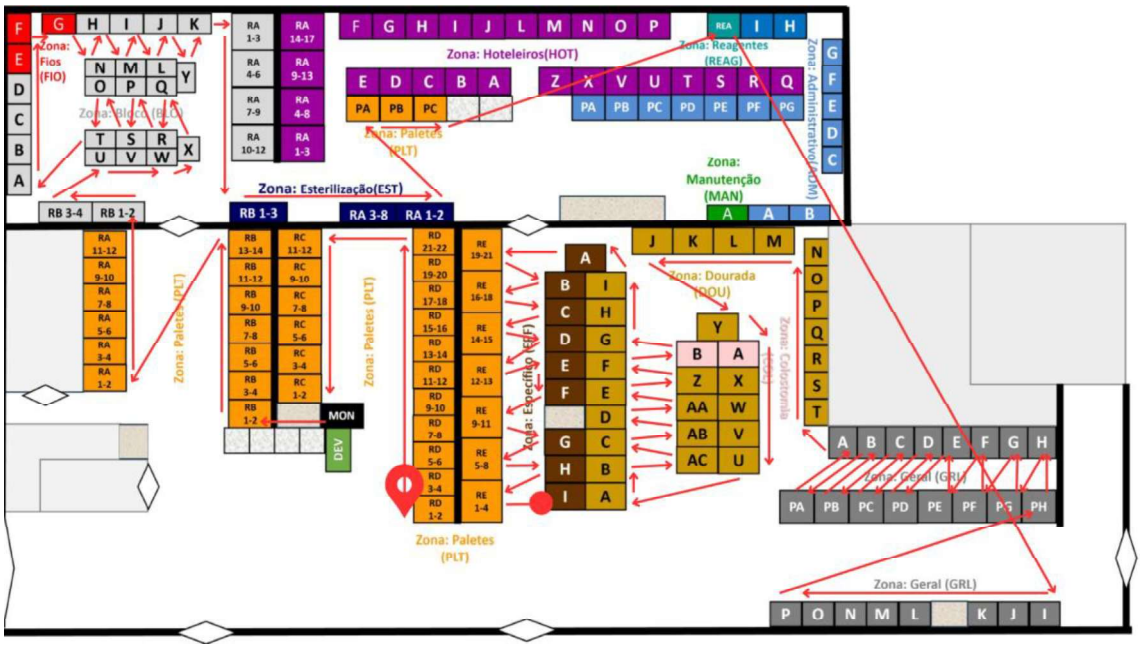
Appendices 6 - Proposed reorganisation of the picking route in the warehouse starting in the General Zone



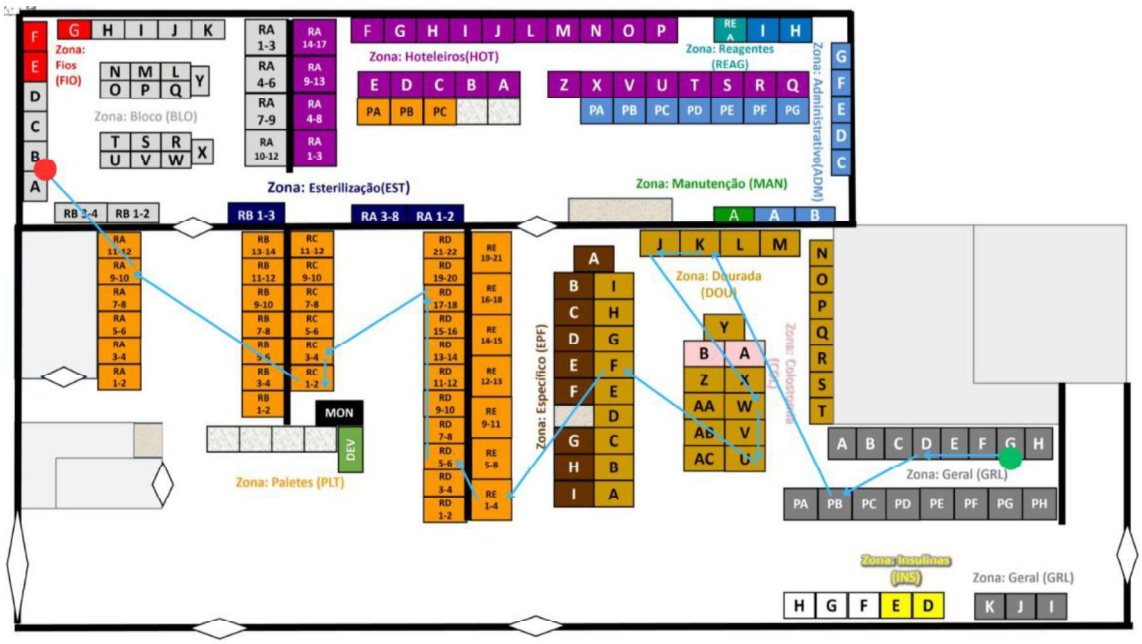
Appendices 7 - Proposed reorganisation of the picking route in the warehouse starting in the Specific Zone



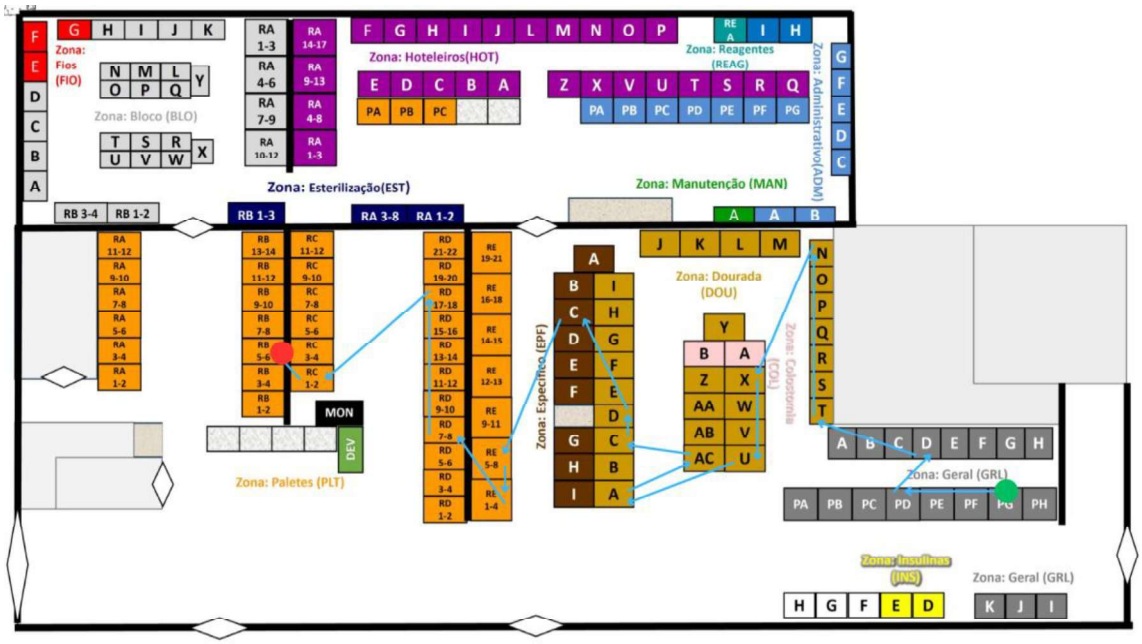
Appendices 8 - Proposed reorganisation of the picking route in the warehouse starting in the Pallets Zone



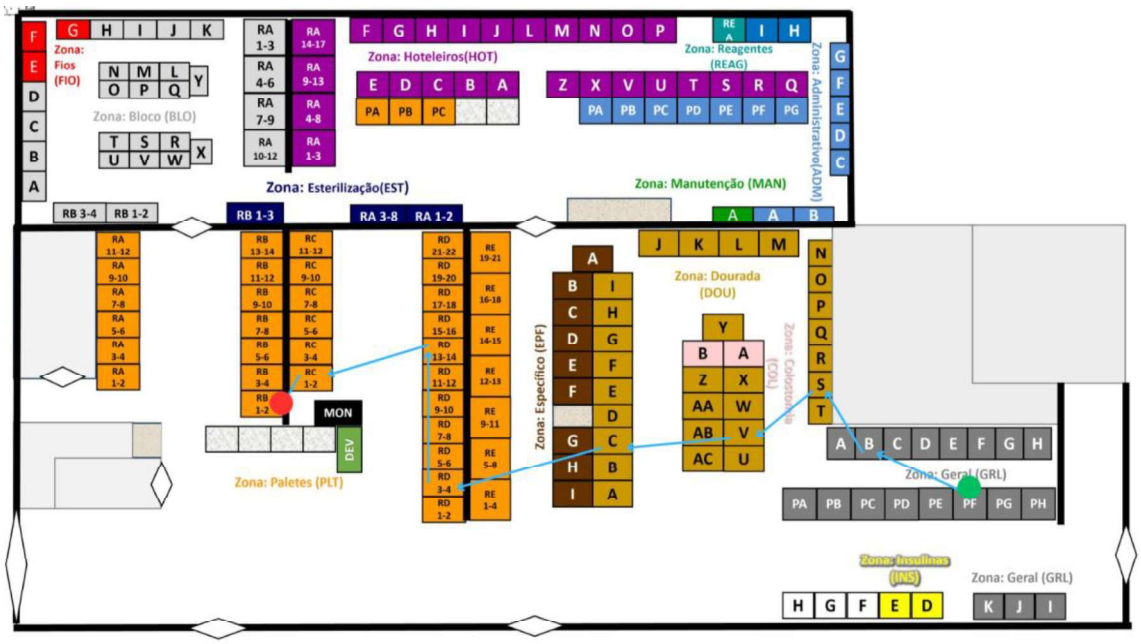
Appendices 9 - Analysis of Picking Routes Following Route Sequence Reorganisation: Sample 1



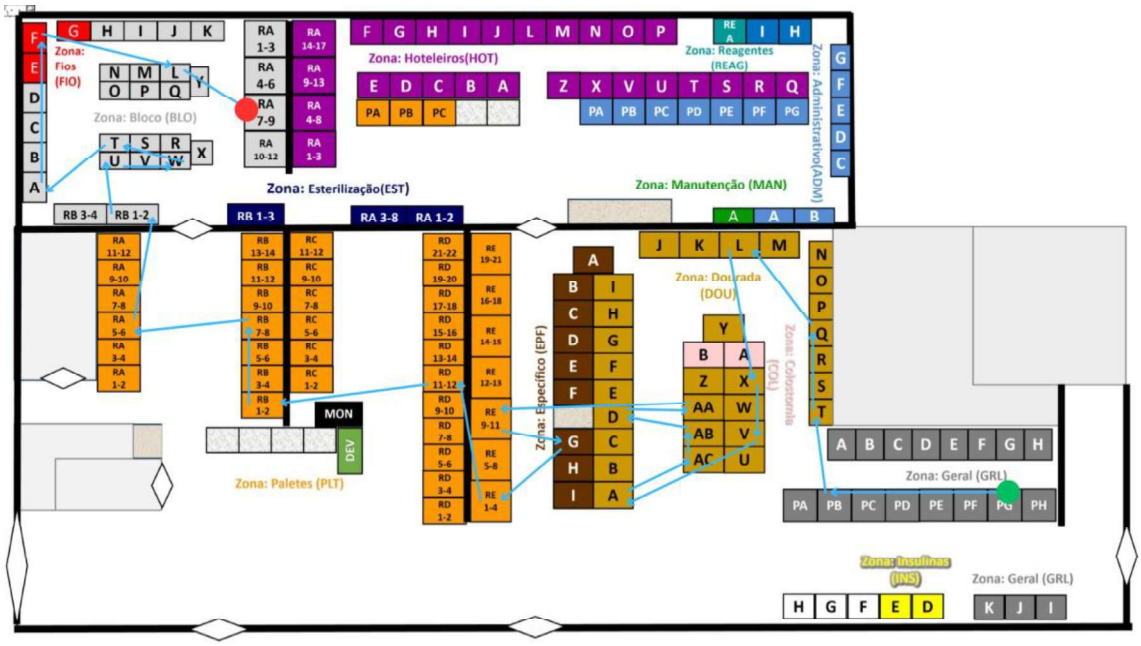
Appendices 10 - Analysis of Picking Routes Following Route Sequence Reorganisation: Sample 2



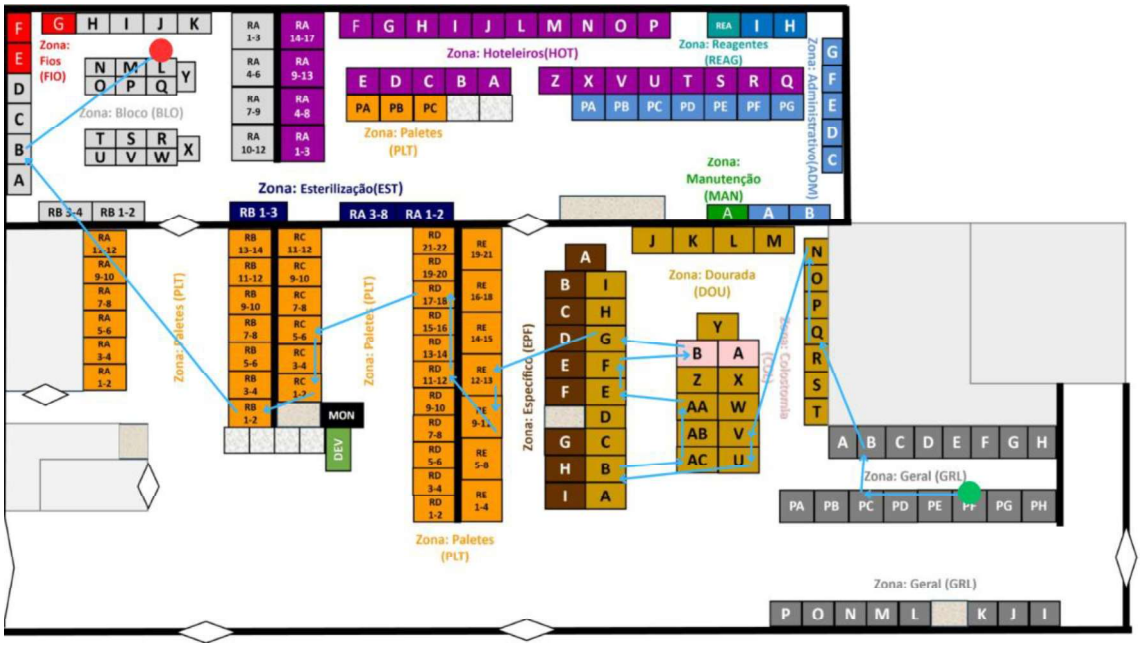
Appendices 11 - Analysis of Picking Routes Following Route Sequence Reorganisation: Sample 3



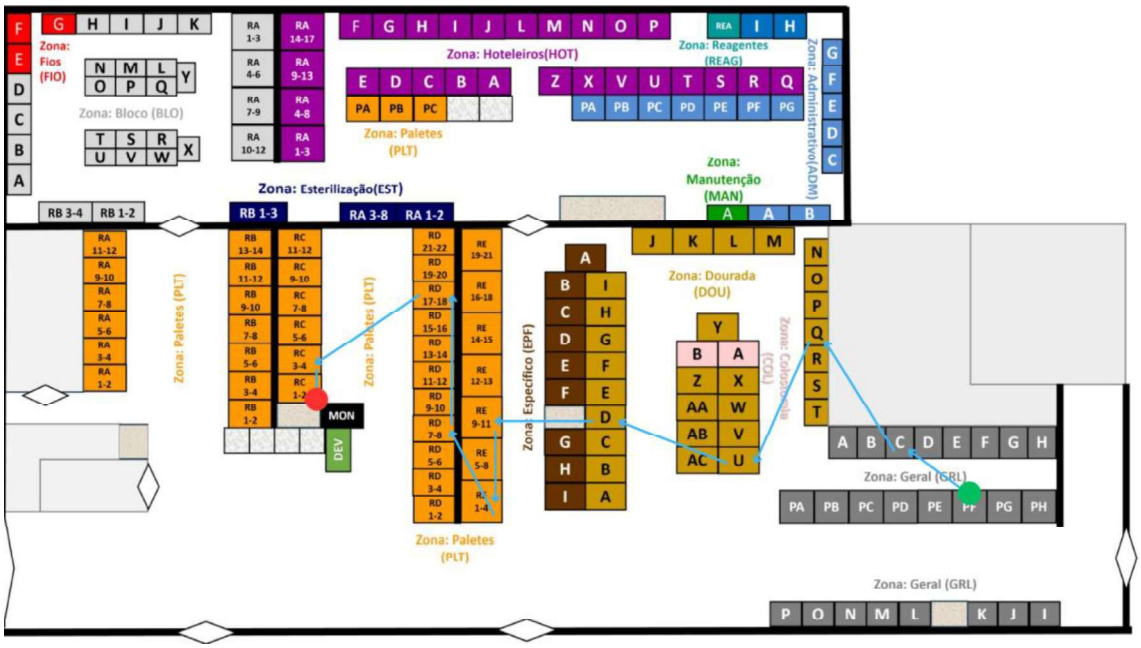
Appendices 12 - Analysis of Picking Routes Following Route Sequence Reorganisation: Sample 4



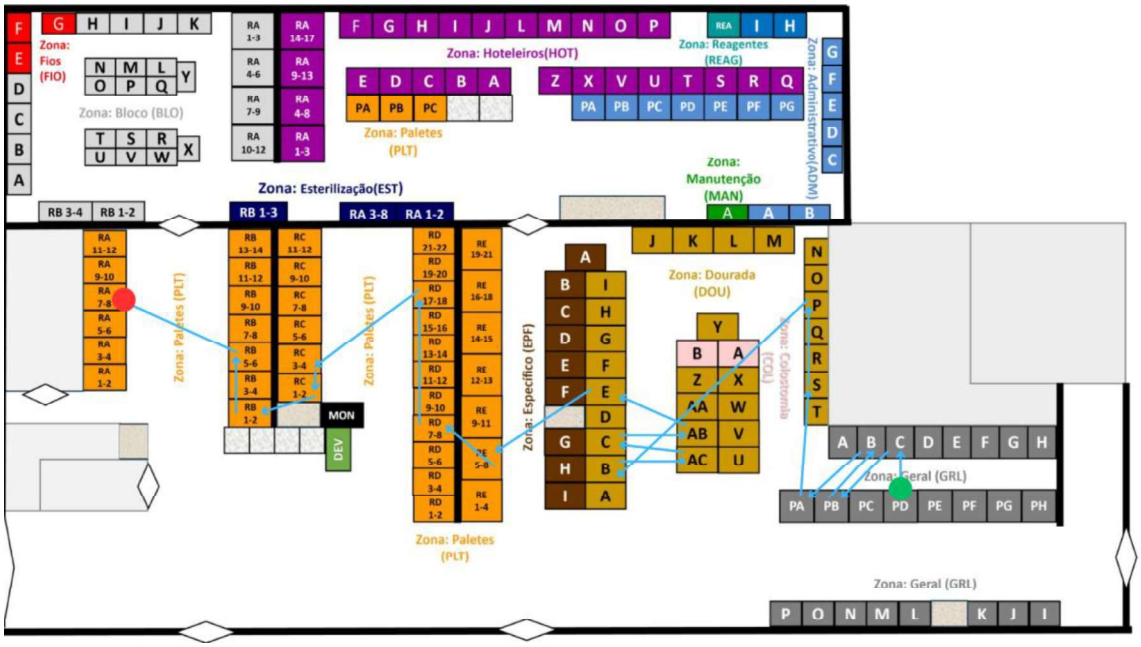
Appendices 13 - Analysed Picking Routes after Updating the Picking Route: Sample A



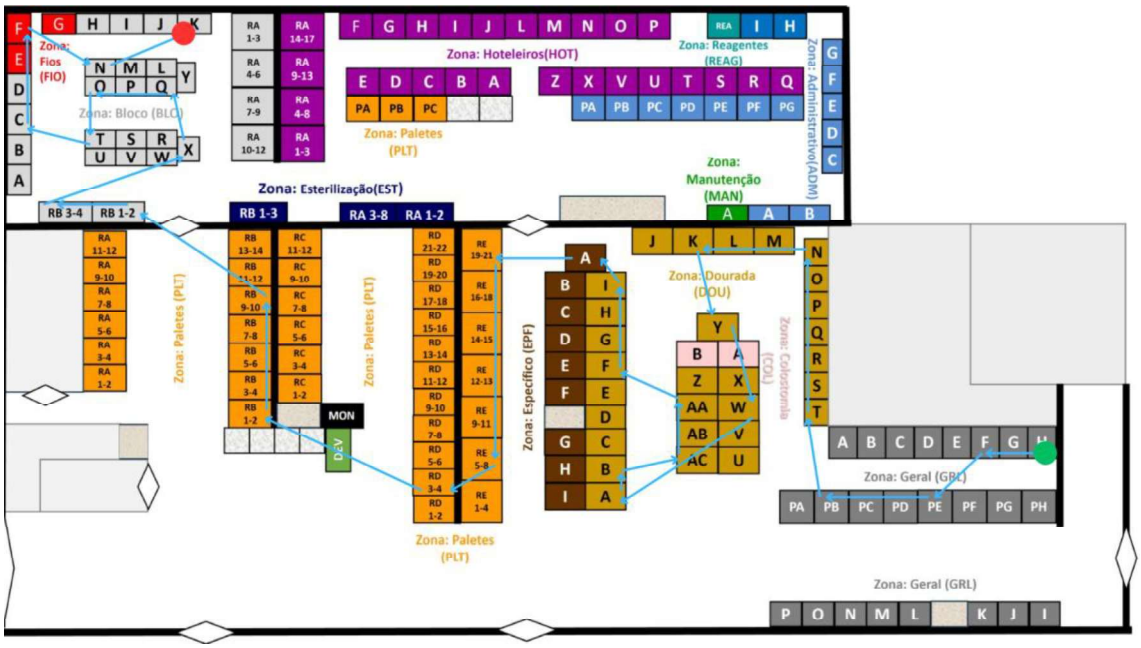
Appendices 14 - Analysed Picking Routes after Updating the Picking Route: Sample B



Appendices 15 - Analysed Picking Routes after Updating the Picking Route: Sample C



Appendices 16 - Analysed Picking Routes after Updating the Picking Route: Sample D



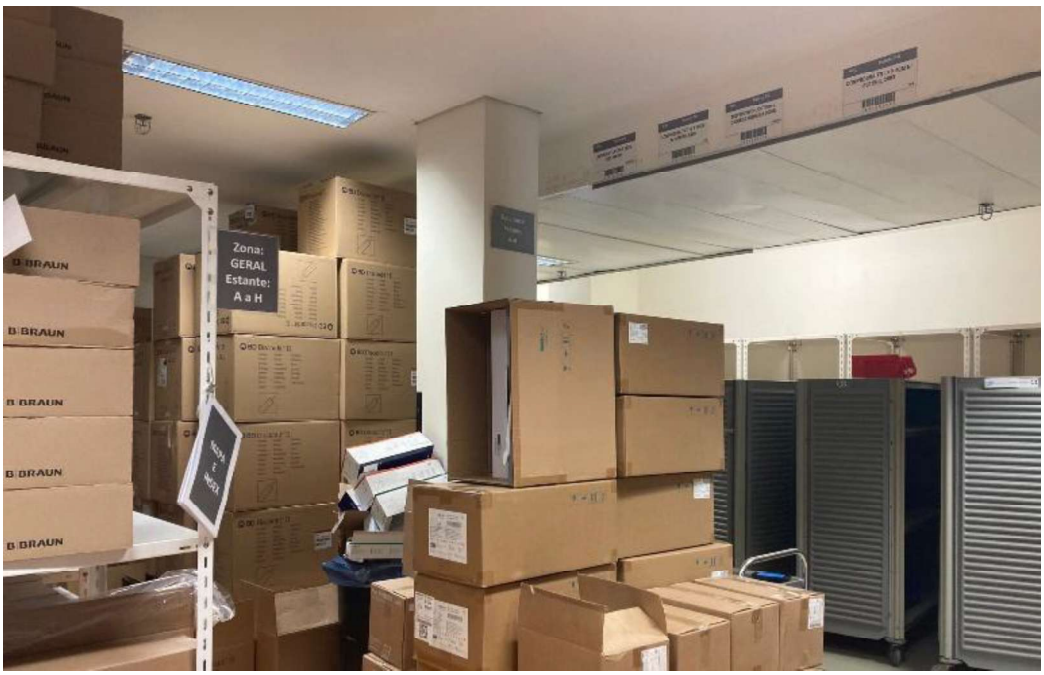
Appendices 17 - Example of Identification in the Operating Block Zone and Item Location Map



Appendices 18 - Storage of Materials at Elevated Heights, Hindering Access, and Identification



Appendices 19 – Example of Identification Labels Positioned the Operator's Direct Field of Vision



Appendices 20 - Implementation of Suspended Item Identification, Improving Information Accessibility and Code Reading during the Picking Process



Appendices 21 – Visual Information on the 5S Methodology



Appendices 22 – 5S Audit Questionnaire

Verificação - Metodologia 5S

Este formulário destina-se à realização de uma verificação baseada na metodologia 5S nas diferentes áreas do sistema logístico da ULSM. A avaliação, pretende identificar oportunidades de melhoria ao nível da organização do espaço, identificação de materiais, limpeza e padronização das práticas operacionais.

* Indica uma pergunta obrigatória

1. Identifique o seu nome. *

Marcar apenas uma oval.

- ◯ Alexandra Morais
- ◯ Filipe Sousa
- ◯ Joaquim Camelo
- ◯ Lígia Simões
- ◯ Marta Lourenço
- ◯ Nilza Craveiro
- ◯ Orlando Magalhães
- ◯ Pedro Leite
- ◯ Soraia Gouveia
- ◯ Vera Lopes

2. Qual o local em que vai ser efetuada a verificação? *

Marcar apenas uma oval.

- ◯ Aquário *Avançar para a pergunta 3*
- ◯ Armazém *Avançar para a pergunta 21*
- ◯ Open Space - Logística *Avançar para a pergunta 3*
- ◯ Pedidos Eletrónicos *Avançar para a pergunta 3*
- ◯ Receção/ Conferência - Clínico *Avançar para a pergunta 3*
- ◯ Receção/ Conferência - Farmácia *Avançar para a pergunta 3*
- ◯ Supermercados: Armazém *Avançar para a pergunta 21*
- ◯ Supermercados: Montagem *Avançar para a pergunta 3*
- ◯ Transportes/ Distribuição *Avançar para a pergunta 3*

Verificação 5S

- **Seiri - Senso de Utilização**: Separar o necessário do desnecessário e eliminar o que não agrega valor.
- **Seiton - Senso de Organização:** Organizar cada coisa no seu lugar, de forma prática e acessível.
- **Seiso - Senso de Limpeza:** Manter o ambiente limpo e identificar fontes de sujidade ou problemas.
- **Seiketsu - Senso de Padronização:** Criar padrões e rotinas para manter os três primeiros S continuamente.
- **Shitsuke - Senso de Disciplina:** Desenvolver o hábito e a disciplina para seguir os padrões e atingir a melhoria continua.

Se encontrar menos de 6 exemplos, avaliar entre 7 e 10.
Se encontrar entre 6 a 15 exemplos, avaliar entre 4 e 6.
Se encontrar mais de 15 exemplos, avaliar entre 3 e 1.

3. 1. **Seiri** - Existem documentos desatualizados/acumulados, materiais administrativos desnecessários ou caixas vazias no espaço de trabalho?

Se encontrar 4 exemplos ou menos, avaliar entre 7 e 10.
Se encontrar entre 5 a 7 exemplos, avaliar entre 4 e 6.
Se encontrar 8 exemplos ou mais, avaliar entre 1 e 3.

Marcar apenas uma oval.

	0	1	2	3	4	5	6	7	8	9	10	
Não	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Excelente

4. 2. **Seiri** - Os documentos presentes no local correspondem apenas às atividades atuais?

Se encontrar 4 exemplos ou menos, que não correspondem, avaliar entre 7 e 10.
Se encontrar entre 5 a 7 exemplos, que não correspondem, avaliar entre 4 e 6.
Se encontrar 8 exemplos ou mais, que não correspondem, avaliar entre 1 e 3.

Marcar apenas uma oval.

	0	1	2	3	4	5	6	7	8	9	10	
Não	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Execelente

5. 3. **Seiri** - Indique algumas observações/sugestões que considere pertinentes relativamente à verificação anteriormente realizada.

* 6. 4. **Seiton -** Os documentos encontram-se organizados e identificados de forma clara assim como, em locais devidamente definidos? *

Se encontrar 4 exemplos ou menos, que não estão organizados, avaliar entre 7 e 10.
Se encontrar entre 5 a 7 exemplos, que não estão organizados, avaliar entre 4 e 6.
Se encontrar 8 exemplos ou mais, que não estão organizados, avaliar entre 1 e 3.

Marcar apenas uma oval.

	0	1	2	3	4	5	6	7	8	9	10	
Não	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Excelente

* 7. 5. **Seiton -** O posto de trabalho encontra-se organizado? *

Marcar apenas uma oval.

	0	1	2	3	4	5	6	7	8	9	10	
Não	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Excelente

8. 6. **Seiton -** Existem quadros ou suportes visuais com informação operacional relevante? *

Se encontrar 4 exemplos ou menos, que não contém informação relevante, avaliar entre 7 e 10.
Se encontrar entre 5 a 7 exemplos, que não contém informação relevante, avaliar entre 4 e 6.
Se encontrar 8 exemplos ou mais, que não contém informação relevante, avaliar entre 1 e 3.

Marcar apenas uma oval.

	0	1	2	3	4	5	6	7	8	9	10	
Não	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Excelente

9. 7. **Seiton** - Indique algumas observações/sugestões que considere pertinentes relativamente à verificação anteriormente realizada.

10. 8. **Seiso -** As mesas e áreas de trabalho encontram-se limpas e organizadas? *

Devem estar livres de sujidade ou materiais desnecessários.

Marcar apenas uma oval.

	0	1	2	3	4	5	6	7	8	9	10	
Não	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Excelente

11. 9. **Seiso -** Existem objetos desnecessários no local de trabalho? *

Se encontrar 4 exemplos ou menos, que são desnecessários, avaliar entre 7 e 10.
Se encontrar entre 5 a 7 exemplos, que são desnecessário, avaliar entre 4 e 6.
Se encontrar 8 exemplos ou mais, que são desnecessários, avaliar entre 1 e 3.

Marcar apenas uma oval.

	0	1	2	3	4	5	6	7	8	9	10	
Não	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Excelente

12. 10. **Seiso -** Os equipamentos informáticos encontram-se em bom estado? *

Verificar se os equipamentos encontram-se em funcionamento, sem danos visíveis ou problemas que comprometam a sua utilização.

Marcar apenas uma oval.

	0	1	2	3	4	5	6	7	8	9	10	
Não	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Excelente

13. 11. **Seiso** - Indique algumas observações/sugestões que considere pertinentes relativamente à verificação anteriormente realizada.

14. 12. **Seiketsu -** Existe padronização na organização dos documentos e arquivos? *

Verificar se a organização dos documentos e arquivos segue um padrão definido, garantindo consistência na sua arrumação e identificação.

Marcar apenas uma oval.

	0	1	2	3	4	5	6	7	8	9	10	
Não	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Excelente

15. 13. **Seiketsu -** Os documentos necessários às atividades da área encontram-se facilmente acessíveis aos colaboradores? *

Marcar apenas uma oval.

	0	1	2	3	4	5	6	7	8	9	10	
Não	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Excelente

16. 14. **Seiketsu** - Indique algumas observações/sugestões que considere pertinentes relativamente à verificação anteriormente realizada.

17. 15. **Shitsuke -** Existe preocupação em manter o espaço organizado? *

Impecavelmente organizado, avaliar entre 8 e 10.
Mais ou menos organizado, avaliar entre 4 e 7.
Horrivelmente organizado, avaliar entre 1 e 3.

Marcar apenas uma oval.

	0	1	2	3	4	5	6	7	8	9	10	
Não	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Excelente

18. 16. **Shitsuke -** Os documentos e materiais encontram-se nos locais devidamente definidos para a sua utilização? *

Se encontrar 4 exemplos ou menos, que não estão nos locais definidos, avaliar entre 7 e 10.
Se encontrar entre 5 a 7 exemplos, que não estão nos locais definidos, avaliar entre 4 e 6.
Se encontrar 8 exemplos ou mais, que não estão nos locais definidos, avaliar entre 1 e 3.

Marcar apenas uma oval.

	0	1	2	3	4	5	6	7	8	9	10	
Não	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Excelente

19. 17. **Shitsuke** - Indique algumas observações/sugestões que considere pertinentes relativamente à verificação anteriormente realizada.

20. 18. Classifique de uma forma geral o estado atual do local onde realizou a verificação. *

Marcar apenas uma oval.

1	2	3	4	5	6	7	8	9	10
◯	◯	◯	◯	◯	◯	◯	◯	◯	◯

Verificação 5S

- **Seiri - Senso de Utilização**: Separar o necessário do desnecessário e eliminar o que não agrega valor.
- **Seiton - Senso de Organização:** Organizar cada coisa no seu lugar, de forma prática e acessível.
- **Seiso - Senso de Limpeza:** Manter o ambiente limpo e identificar fontes de sujidade ou problemas.
- **Seiketsu - Senso de Padronização:** Criar padrões e rotinas para manter os três primeiros S continuamente.
- **Shitsuke - Senso de Disciplina:** Desenvolver o hábito e a disciplina para seguir os padrões e atingir a melhoria continua.

21. 19. Caso a verificação que vai efetuar seja no armazém, por favor indique a respetiva zona.

Marcar apenas uma oval.

- ◯ Geral
- ◯ Dourada/Colostomia
- ◯ Específico
- ◯ Paletes
- ◯ Bloco/Fios
- ◯ Esterilização
- ◯ Administrativa/Reagentes/Manutenção e Conservação
- ◯ Hoteleiro
- ◯ Não Aplicável

22. 20. **Seiri -** Existem materiais/equipamentos desnecessários no chão ou estantes? *

Se encontrar 4 exemplos ou menos, avaliar entre 7 e 10.
Se encontrar entre 5 a 7 exemplos, avaliar entre 4 e 6.
Se encontrar 8 exemplos ou mais, avaliar entre 1 e 3.

Marcar apenas uma oval.

	0	1	2	3	4	5	6	7	8	9	10	
Não	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Excelente

23. 21. **Seiri -** Existem caixas vazias ou plático acumulado nas prateleiras ou racks? *

Se encontrar 4 exemplos ou menos, avaliar entre 7 e 10.
Se encontrar entre 5 a 7 exemplos, avaliar entre 4 e 6.
Se encontrar 8 exemplos ou mais, avaliar entre 1 e 3.

Marcar apenas uma oval.

	0	1	2	3	4	5	6	7	8	9	10	
Não	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Excelente

24. 22. **Seiri -** Existem materiais/artigos acumulados nas estantes/racks sem identificação clara? *

Se encontrar 4 exemplos ou menos, avaliar entre 7 e 10.
Se encontrar entre 5 a 7 exemplos, avaliar entre 4 e 6.
Se encontrar 8 exemplos ou mais, avaliar entre 1 e 3.

Marcar apenas uma oval.

	0	1	2	3	4	5	6	7	8	9	10	
Não	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Excelente

25. 23. **Seiri** - Indique algumas observações/sugestões que considere pertinentes relativamente à verificação anteriormente realizada.

26. 24. **Seiton -** É visível que os artigos contemplam uma localização definida? *

Se encontrar 4 exemplos ou menos, que não contemplam, avaliar entre 7 e 10.
Se encontrar entre 5 a 7 exemplos, que não contemplam, avaliar entre 4 e 6.
Se encontrar 8 exemplos ou mais, que não contemplam , avaliar entre 1 e 3.

Marcar apenas uma oval.

	0	1	2	3	4	5	6	7	8	9	10	
Não	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Excelente

27. 25. **Seiton -** As prateleiras e zonas do armazém estão devidamente identificadas? *

Se encontrar 4 exemplos ou menos, que não estão devidamente identificadas, *avaliar entre 7 e 10.*
Se encontrar entre 5 a 7 exemplos, que não estão devidamente identificadas, *avaliar entre 4 e 6.*
Se encontrar 8 exemplos ou mais, que não estão devidamente identificadas, *avaliar entre 1 e 3.*

Marcar apenas uma oval.

	0	1	2	3	4	5	6	7	8	9	10	
Não	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Excelente

28. 26. **Seiton -** As marcações no chão permitem identificar claramente os locais destinados a equipamentos e materiais? *

Se encontrar 4 exemplos ou menos, que não estão marcados, *avaliar entre 7 e 10.*
Se encontrar entre 5 a 7 exemplos, que não estão marcados, *avaliar entre 4 e 6.*
Se encontrar 8 exemplos ou mais, que não estão marcados, *avaliar entre 1 e 3.*

Marcar apenas uma oval.

	0	1	2	3	4	5	6	7	8	9	10	
Não	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Excelente

29. 27. **Seiri** - Indique algumas observações/sugestões que considere pertinentes relativamente à verificação anteriormente realizada.

30. 28. **Seiso -** O chão encontra-se limpo e livre de resíduos? *

Se encontrar 4 exemplos ou menos, que não estão limpos e livre de resíduos, avaliar entre 7 e 10.
Se encontrar entre 5 a 7 exemplos, que não estão limpos e livre de resíduos, avaliar entre 4 e 6.
Se encontrar 8 exemplos ou mais, que não estão limpos e livre de resíduos, avaliar entre 1 e 3.

Marcar apenas uma oval.

	0	1	2	3	4	5	6	7	8	9	10	
Não	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Excelente

31. 29. **Seiso -** As estantes e prateleiras encontram-se limpas? *

Se encontrar 4 exemplos ou menos, que não estão limpas, avaliar entre 7 e 10.
Se encontrar entre 5 a 7 exemplos, que não estão limpas, avaliar entre 4 e 6.
Se encontrar 8 exemplos ou mais, que não estão limpas, avaliar entre 1 e 3.

Marcar apenas uma oval.

	0	1	2	3	4	5	6	7	8	9	10	
Não	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Excelente

32. 30. **Seiso -** Os corredores estão livres para circulação de carrinhos/camiões para apoio ao picking? *

Se encontrar 4 exemplos ou menos, que não estão livres, avaliar entre 7 e 10.
Se encontrar entre 5 a 7 exemplos, que não estão livres, avaliar entre 4 e 6.
Se encontrar 8 exemplos ou mais, que não estão livres, avaliar entre 1 e 3.

Marcar apenas uma oval.

	0	1	2	3	4	5	6	7	8	9	10	
Não	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Excelente

33. 31. **Seiso** - Indique algumas observações/sugestões que considere pertinentes relativamente à verificação anteriormente realizada.

_____

_____

_____

_____

_____

34. 32. **Seiketsu -** Os Kanbans de armazém definem claramente o Ponto de Encomenda e a Quantidade a Encomendar? *

Se encontrar 4 exemplos ou menos, que não definem, avaliar entre 7 e 10.
Se encontrar entre 5 a 7 exemplos, que não definem, avaliar entre 4 e 6.
Se encontrar 8 exemplos ou mais, que não definem, avaliar entre 1 e 3.

Marcar apenas uma oval.

	0	1	2	3	4	5	6	7	8	9	10	
Não	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Excelente

35. 33. **Seiketsu** - Os Kanban's estão visíveis e corretamente posicionados na localização dos artigos? *

Se encontrar 4 exemplos ou menos, que não estão vísiveis, avaliar entre 7 e 10.
Se encontrar entre 5 a 7 exemplos, que não estão vísiveis, avaliar entre 4 e 6.
Se encontrar 8 exemplos ou mais, que não estão vísiveis, avaliar entre 1 e 3.

Marcar apenas uma oval.

	0	1	2	3	4	5	6	7	8	9	10	
Não	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Excelente

36. 34. **Seiketsu -** O Ponto de Encomenda já foi atingido, contudo, o Kanban ainda continua colocado no artigo? *

Verificar se, após atingir o ponto de encomenda, o Kanban foi corretamente removido do artigo ou se ainda permanece na sua localização.

Marcar apenas uma oval.

- ◯ Sim
- ◯ Não
- ◯ Não Aplicável

37.

35. **Seiketsu** - Quantos Kanban's encontrou com o Ponto de Encomenda ultrapassado?

38. 36. **Seiketsu** - Indique algumas observações/sugestões que considere pertinentes relativamente à verificação anteriormente realizada.

39. *

37. **Shitsuke -** Os colaboradores respeitam as localizações definidas para os equipamentos?

Se encontrar 4 exemplos ou menos, que não respeitam, avaliar entre 7 e 10.
Se encontrar entre 5 a 7 exemplos, que não respeitam, avaliar entre 4 e 6.
Se encontrar 8 exemplos ou mais, que não respeitam, avaliar entre 1 e 3.

Marcar apenas uma oval.

	0	1	2	3	4	5	6	7	8	9	10	
Não	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Excelente

40. 38. **Shitsuke -** Os colaboradores mantém a organização do espaço de trabalho durante, ou após, as operações de picking? *

Se encontrar 4 exemplos ou menos, que não mantém a organização, avaliar entre 7 e 10.
Se encontrar entre 5 a 7 exemplos, que não mantém a organização, avaliar entre 4 e 6.
Se encontrar 8 exemplos ou mais, que não mantém a organização , avaliar entre 1 e 3.

Marcar apenas uma oval.

	0	1	2	3	4	5	6	7	8	9	10	
Não	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Excelente

41. 39. **Shitsuke** - Indique algumas observações/sugestões que considere pertinentes relativamente à verificação anteriormente realizada.

42. 40. Classifique de uma forma geral o estado atual do local onde realizou a verificação. *

1	2	3	4	5	6	7	8	9	10
☆	☆	☆	☆	☆	☆	☆	☆	☆	☆

Este conteúdo não foi criado nem aprovado pela Google.

Google Formulários

Appendices 23 – Pilot Audits

ID	1	2	3
Identifique o seu nome.	Pessoa A	Pessoa B	Pessoa C
Qual o local em que vai ser efetuada a verificação?	Armazém	Receção - Farmácia	Aquário
1. Seiri - Existem documentos desatualizados/acumulados, materiais administrativos desnecessários ou caixas vazias no espaço de trabalho?	0	8	3
2. Seiri - Os documentos presentes no local de trabalho correspondem apenas às atividades atuais?	0	10	10
3. Seiri - Indique algumas observações/sugestões que considere pertinentes relativamente à verificação anteriormente realizada.	0	0	0
4. Seiton - Os documentos encontram-se organizados e identificados de forma clara assim como, em locais devidamente definidos?	0	9	5
5. Seiton - O/s posto/s de trabalho encontra-se organizado?	0	6	8
6. Seiton - Existem quadros ou suportes visuais com informação operacional relevante?	0	9	6
7. Seiton - Indique algumas observações/sugestões que considere pertinentes relativamente à verificação anteriormente realizada.	0	0	0
8. Seiso - As mesas e áreas de trabalho encontram-se limpas e organizadas?	0	6	8
9. Seiso - Existem objetos desnecessários no local de trabalho?	0	10	4
10. Seiso - Os equipamentos informáticos encontram-se em bom estado?	0	9	9

11. Seiso - Indique algumas observações/sugestões que considere pertinentes relativamente à verificação anteriormente realizada.	0	0	Objetos não relevantes encontrados no local de trabalho. Ex: suporte de cadeiras, palitos, sacos de plástico, máscaras
12. Seiketsu - Existe padronização na organização dos documentos e arquivos?	0	4	5
13. Seiketsu - Os documentos necessários às atividades da área encontram-se facilmente acessíveis aos colaboradores?	0	7	10
14. Seiketsu - Indique algumas observações/sugestões que considere pertinentes relativamente à verificação anteriormente realizada.	0	0	0
15. Shitsuke - Existe preocupação em manter o espaço organizado?	0	6	4
16. Shitsuke - Os documentos e materiais encontram-se nos locais devidamente definidos para a sua utilização?	0	9	9
17. Shitsuke - Indique algumas observações/sugestões que considere pertinentes relativamente à verificação anteriormente realizada.	0	0	0
18. Classifique de uma forma geral o estado atual do local onde realizou a verificação.	0	7	6
19. Caso a verificação que vai efetuar seja no armazém, por favor indique a respetiva zona.	Dourada/Colostomia	0	0
20. Seiri - Existem materiais/equipamentos desnecessários no chão ou estantes?	5	0	0
21. Seiri - Existem caixas vazias ou plástico acumulado, nas prateleiras ou racks?	4	0	0

22. Seiri - Existem materiais/artigos acumulados nas estantes/racks sem identificação clara?	7	0	0
23. Seiri - Indique algumas observações/sugestões que considere pertinentes relativamente à verificação anteriormente realizada.	0	0	0
24. Seiton - É visível que os artigos contemplam uma localização definida?	10	0	0
25. Seiton - As prateleiras e zonas do armazém estão devidamente identificadas?	10	0	0
26. Seiton - As marcações no chão permitem identificar claramente os locais destinados a equipamentos e materiais?	10	0	0
27. Seiri - Indique algumas observações/sugestões que considere pertinentes relativamente à verificação anteriormente realizada.	0	0	0
28. Seiso - O chão encontra-se limpo e livre de resíduos?	5	0	0
29. Seiso - As estantes e prateleiras encontram-se limpas?	1	0	0
30. Seiso - Os corredores estão livres para circulação de carrinhos/camiões para apoio ao picking?	4	0	0
31. Seiso - Indique algumas observações/sugestões que considere pertinentes relativamente à verificação anteriormente realizada.	0	0	0
32. Seiketsu - Os Kanban's de armazém definem claramente o Ponto de Encomenda e a Quantidade a Encomendar?	10	0	0
33. Seiketsu - Os Kanban's estão visíveis e corretamente posicionados na localização dos artigos?	5	0	0
34. Seiketsu - O Ponto de Encomenda já foi atingido, contudo, o Kanban ainda continua colocado no artigo?	Sim	0	0
35. Seiketsu - Quantos Kanban's encontrou com o Ponto de Encomenda ultrapassado?	2	0	0

36. Seiketsu - Indique algumas observações/sugestões que considere pertinentes relativamente à verificação anteriormente realizada.	0	0	0
37. Shitsuke - Os colaboradores respeitam as localizações definidas para os equipamentos?	7	0	0
38. Shitsuke - Os colaboradores mantém a organização do espaço de trabalho durante, ou após, as operações de picking?	4	0	0
39. Shitsuke - Indique algumas observações/sugestões que considere pertinentes relativamente à verificação anteriormente realizada.	0	0	0
40. Classifique de uma forma geral o estado atual do local onde realizou a verificação.	6	0	0

Appendices 24 – Proposed Sequence for Internal Distribution

Piso	Ordem	Paragem
Piso -1	1	Viatura Médica de Emergência Reanimação
	2	Logística – Armazém
	3	Logística – Distribuição
	4	Serviço de Compras
	5	Farmácia
	6	Rouparia
	7	Esterilização
	8	Oficinas
	9	Logística – Arquivo Clínico
	10	Serviço Social
	11	Departamento da Qualidade
	12	Unidade Medicina Hiperbárica
	13	C.E. Medicina Hiperbárica
	14	Gabinete de Saúde Ocupacional
	15	SADMIN – Comissões Técnicas
	16	Gabinete Coordenação da Gestão de Risco
	17	Entrada do Pessoal
	18	Emergência
	19	Emergência OBS
	20	URG – Urgência Geral
	21	Secretariado – Admissão de Emergência
	22	Serviço Medicina Intensiva
	23	SMI – Bloco Central
	24	Técnicas Invasivas de Medicina
	25	SADMIN - Centro de Formação
	26	SADMIN - Internato Médico
	27	C.E. Pediatria
	28	Medicina Física e Reabilitação
	29	C.E. MFR
	30	Psicologia
	31	Hospital de dia – Psiquiatria
	32	H.DIA - PSIQ ALD
	33	C.E. Psiq. Infância e Adolescência HPH
	34	C.E. Psiq. Infância e Adolescência ACES
	35	Psiquiatria HPH
	36	Urgência Psiquiatria

	37	Casa Mortuária
Piso 0	1	Anatomia Patológica
	2	Patologia Clínica
	3	Hospital de dia
	4	Hospital de dia - Imuno-Hemoterapia
	5	Hospital de Dia - Quimioterapia
	6	C.E. Hematologia Clínica
	7	Hospital de Dia - Hematologia Clínica
	8	Hemoterapia
	9	LAC/ Microbiologia
	10	LAC/ Bioquímica
	11	LAC/ Imunologia
	12	LAC/ Hematologia
	13	SADMIN - Departamento de Anestesia
	14	Anestesiologia
	15	Serviço de Informática
	16	Serviço de Pessoal
	17	Assessoria de Imprensa
	18	Serviços Hoteleiros
	19	Serviço de Viaturas
	20	Central Telefónica
	21	Serviços Jurídicos e de Contencioso
	22	Serviço Instalações e Equipamentos
	23	Serviços Financeiros
	24	Gabinete de Codificação
	25	Conselho Clínico – ACES
	26	Supervisão de Enfermagem
	27	Auditoria Interna
	28	Gabinete Contratualização
	29	Serviço Planeamento e Controlo Gestão
	30	Gab. Reeng. Simplificação Processos
	31	Conselho de Administração
	32	Cirurgia de Ambulatório
	33	Cirurgia Ambulatório - Urologia
	34	Serviços Religiosos
	35	Secretariado – Exames Especiais

	36	C.E. Dor Crónica
	37	Exames Especiais Ginecologia/ Obstetrícia
	38	Exames Especiais Gastroenterologia
	39	Exames Especiais Otorrino
	40	Exames Especiais Cardiologia
	41	Exames Especiais Dermatologia
	42	Exames Especiais
	43	Secretariado - Consulta EXT
	44	Consulta Externa
	45	C.E. Pneumologia
	46	C.E. Gastroenterologia
	47	Un. Hosp. CTH
	48	Farmácia (FA2-ONC)
	49	Gabinete do Cidadão
	50	Logística - Transportes Doentes
	51	Responsável p/ Acesso à Informação
	52	Visitas
	53	Serviço de Admissão de Doentes
Piso 1	1	Bloco Central
	2	UCIP
	3	Cirurgia B
	4	SADMIN – UHGIC
	5	Unidade Planeamento Cirúrgico
	6	Pediatria A
	7	Cirurgia C
	8	Imagiologia
	9	C.E. Pequena Cirurgia
Piso 2	1	Biblioteca
	2	Serviço Investigação Epidemiológica Clínica Saúde Pública Hospital
	3	Investigação
	4	Unidade Apoio Gestão – ACES
	5	Departamento de Medicina
	6	Departamento de Cirurgia
	7	Secretariado - dep. Cirurgia
	8	Medicina F
	9	Medicina D

	10	Medicina UAVC
	11	Medicina E
Piso 3	1	Bloco de Partos
	2	UCI Neonatal
	3	Unidade Materno Fetal
	4	Obstetrícia J
	5	Exames Especiais Broncologia
	6	Técnicas Nefrologia
	7	Neurologia
	8	TIM – Nefrologia
	9	Dietética / Nutrição
	10	Departamento Obstetrícia/Ginecologia
	11	Ginecologia I
	12	Cirurgia I
	13	Ortopedia
Piso 4	1	Medicina M
	2	Urologia L
	3	Medicina O
	4	Otorrinolaringologia
	5	Oftalmologia
	6	Medicina L
	7	UADCI - Un. Adm. Doente Cir. Int.
	8	Gestão de Altas
	9	Equipa Intra-Hospitalar de Cuidados Paliativos
	10	EDCC - Equipa Doente Crónico Complexo
	11	Visitas Domiciliárias Cuidados Paliativos

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ANNEXES

Annex 1 – XYZ Classification of 25 Items Located in the Specific Zone

Código do Artigo	Nome do Artigo	Número de dias de Picking	XYZ	ABC
1007000118	PENSO POS-OPERATORIO, IMPERMEAVEL, C/ REDE DE POLIURETANO, SEMI-OCLUSIVO 20X10CM	17	Z	C
1007000119	PENSO POS-OPERATORIO, IMPERMEAVEL, C/ REDE DE POLIURETANO, SEMI-OCLUSIVO 30X10CM	19	Z	C
1021000010	ALGODAO HIDROFILO 100G	79	Z	C
1031200348	AGULHA 30G X 1,2" - 13 3/10 HIPODERMICA	58	Z	C
1031500030	AGULHA IM 27G X 1/2 0.4X13MM	43	Z	C
1032200050	AGULHA SUBCUTANEA 25GX1 0,50X25MM PERIBULBAR	60	Z	C
1054000301	PROLONGAMENTO DE CATETER 13CM	63	Z	C
1054500001	CATETER EPICUTANEO 2F	29	Z	C
1081000112	CONECTOR MACHO FECHADO COM TAMPA	5	Z	C
1104000015	VALVULA UNID. DRENAGEM TORAX. SIMPLES	18	Z	C
1209500095	MANGUITO PLASTICO DESCARTAVEL	68	Y	B
1212700028	FILTRO BACTERIOLOGICO P/VACUOMETRO	12	Z	C
1261200194	COBERTOR CORPO INTEIRO P/ SISTEMA WARM-TOUCH	172	Y	C
1261500202	CAMARA EXPANSORA AUTOCLAVÁVEL ADULTO	99	Y	C
1276000020	SACO P/CLISTER	38	Z	C
1294000011	SISTEMA DRENAGEM PLEURAL PLEUROCAN -> 4462556	74	Z	C
1337000008	CIRCUITO RESPIRATORIO P/TERAPIA ALTO FLUXO ADULTO/JUNIOR	32	Z	C
1337000009	CIRCUITO P/ VENTILADOR C/ SAÍDA RESPIRATÓRIA (RT319)	33	Z	C
1364000026	CANULA NASAL P/AIRVO2 TAM. M	21	Z	C
1364000027	CANULA NASAL P/AIRVO2 TAM. L	12	Z	C
1371500060	TERMOMETRO CLíNICO DIGITAL	133	Y	C

1381000003	TAG DE SISTEMA ANTI-RAPTO C/SENSOR DE PELE (BABYSENSE)	4	Z	C
1381000004	PULSEIRA P/ TAG SISTEMA ANTI-RAPTO BEBÉ	40	Z	C
1381000005	PULSEIRA P/ TAG SISTEMA ANTI-RAPTO CRIANÇA	24	Z	C
1401000001	PASTA DENTIFRICA	59	Z	0

Annex 2 - XYZ Classification of 15 Items Located in the General Zone

Código do Artigo	Nome do Artigo	Número de dias de Picking	XYZ	ABC
1022000020	COTONETE EMBALAGEM	258	X	C
1061000029	COMPRESSA DRENAGEM 6X7	12	Z	C
1112500800	KIT DE TRACÇÃO ADESIVA - ADULTO	29	Z	C
1142000010	LIGADURA CAMBRIC 5 X 5	64	Z	C
1142000025	LIGADURA CAMBRIC 10 X 10	99	Z	C
1142000030	LIGADURA CAMBRIC 10 X 15	49	Z	C
1142000035	LIGADURA CAMBRIC 10 X 20	68	Y	C
1143500058	LIGADURA ELASTICA CURTA TRAÇÃO 8CM	63	Y	C
1143500059	LIGADURA ELASTICA CURTA TRAÇAO 10CM	83	Y	C
1144500020	LIGADURA ELASTICA ADESIVA 7,5CM	21	Z	C
1144500025	LIGADURA ELASTICA ADESIVA 10CM	86	Y	C
1275000030	SACO URINA DE PERNA 750CC	111	Y	C
1275000052	SACO COLECTOR DE URINA TUBO DE 150CM	13	Z	C
1331000039	FILTRO BACTERIANO P/ VENTILADOR -> REFª 1944	231	X	C
1186000001	BOLSA TRANSDUTOR DE TELEMETRIA	41	Z	C