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MANAGING INFORMATION FLOWS IN PHARMACY CHAINS BASED ON LOGISTICS PRINCIPLES

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Abstract
In the context of digital transformation and increasing competition in the pharmaceutical market, effective management of information flows has become a key factor in improving the performance of pharmacy chains. Fragmentation of data, lack of integration between operational units, and inefficient inventory and order management negatively affect logistics costs and service quality. This study aims to develop a logistics-based approach to managing information flows in pharmacy chains. The research is based on system analysis, economic and statistical methods, and modeling techniques. The study analyzes the current state of the pharmaceutical retail market in Uzbekistan and identifies key problems in information support for pharmacy chains. As a result, an organizational model for information support of order management and a methodological approach to inventory optimization were proposed. The implementation of the proposed model contributes to reducing logistics costs, increasing inventory turnover, and improving coordination between pharmacies and distribution centers.

Keywords: Pharmacy chains, information flows, logistics, inventory management, order management, pharmaceutical market.

Introduction

The pharmaceutical sector plays a crucial role in ensuring public health, social well-being, and economic stability. Pharmacy chains, as key components of pharmaceutical distribution infrastructure, significantly influence the availability, affordability, and quality of medicines for the population. In many countries, including Uzbekistan, the development of pharmacy chains has become a dominant trend in retail pharmaceutical distribution, driven by market consolidation, urbanization, and the increasing demand for pharmaceutical products.

In recent years, the pharmaceutical market of Uzbekistan has demonstrated steady growth in monetary terms, largely influenced by inflationary factors and increasing demand for imported medicines. At the same time, physical sales volumes show a more restrained dynamic, indicating structural imbalances within the market. The growing dependence on imported pharmaceutical products, combined with rising logistics and operational costs, places additional pressure on pharmacy chains and highlights the importance of efficient logistics management.

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Under these conditions, pharmacy chains face significant challenges related to fragmented information systems, limited integration between operational units, and the lack of real-time access to reliable data. Information flows related to procurement, inventory management, distribution, and retail sales are often dispersed across different subsystems and organizational levels. This fragmentation hinders timely and well-informed decision-making, increases uncertainty in demand forecasting, and leads to excessive inventories, stock imbalances, and financial losses.

The absence of integrated information flow management also reduces the transparency and controllability of logistics processes, making it difficult for pharmacy chains to respond promptly to market changes and regulatory requirements. As competition in the pharmaceutical retail market intensifies, the ability to efficiently manage information resources becomes a critical factor in maintaining operational efficiency and competitive advantage.

Therefore, the development of an integrated system for managing information flows based on logistics principles represents a relevant scientific and practical task. Such a system should ensure coordination between supply, storage, and retail units, support real-time monitoring of logistics processes, and enhance the quality of managerial decision-making. Addressing these challenges contributes to improving the sustainability and long-term competitiveness of pharmacy chains in the evolving pharmaceutical market.

Theoretical Foundations of Information Flow Management in Logistics

Information is considered one of the most important strategic resources in modern logistics systems. Unlike material resources, information does not deplete but increases its value through accumulation and effective use. In logistics, information flows accompany material flows and ensure planning, coordination, monitoring, and control of logistics operations.

Logistics information flows are characterized by timeliness, reliability, relevance, completeness, and structured presentation. Failure to meet these requirements results in delays, inaccurate forecasting, and inefficient inventory management. In pharmacy chains, information flows connect procurement, warehousing, transportation, and retail sales, forming a unified logistics system.

The effective functioning of logistics systems requires the integration of information resources across all hierarchical levels of management. Centralized information systems enable real-time data exchange, improve transparency, and support strategic and operational decision-making.

Analysis of Information Flow Management in Pharmacy Chains

The pharmaceutical retail market in Uzbekistan is characterized by rapid monetary growth driven primarily by inflation factors, while physical sales volumes show a declining trend. Pharmacy chains dominate retail pharmaceutical distribution and increasingly rely on centralized management structures.

However, empirical analysis reveals that information within pharmacy chains is often fragmented, heterogeneous, and distributed across individual pharmacies and departments. Managers frequently face incomplete, inconsistent, or outdated data, which complicates inventory planning and order management.

The study shows that inefficient information flow management leads to excessive safety stocks, low inventory turnover, delayed replenishment, and increased logistics costs. These issues highlight the

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need for a unified information support system that integrates all logistics processes within pharmacy chains.

Development of an Information Model for Order Management

Based on logistics principles, an organizational information model for order management in pharmacy chains was developed to address the problem of fragmented data and inefficient coordination between operational units. The proposed model is designed as an integrated information environment that connects retail pharmacies, distribution centers, and central management into a single decision-support system.

The core objective of the model is to ensure synchronization between material and information flows throughout the entire logistics chain. Unlike traditional decentralized systems, where pharmacies operate autonomously with limited data exchange, the proposed model establishes a centralized information architecture that enables real-time visibility of inventory levels, demand patterns, and supply constraints.

The model provides the following functional capabilities:

Centralized data collection and processing, allowing information from all pharmacies and distribution centers to be accumulated, standardized, and analyzed within a single database. This eliminates data inconsistency and reduces the risk of managerial errors caused by incomplete or outdated information.

Real-time monitoring of inventory levels, ensuring continuous control over stock availability across the entire pharmacy chain. This functionality supports early identification of potential shortages or overstock situations and enables proactive decision-making.

Automated order generation based on demand analysis, which incorporates historical sales data, demand variability, and delivery lead times. Orders are generated dynamically, reducing reliance on manual planning and minimizing subjective decision-making.

Operational coordination between pharmacies and distribution centers, ensuring alignment of replenishment schedules, transportation planning, and warehouse operations. This improves the reliability of deliveries and reduces delays within the supply chain.

Within the proposed model, a methodological approach to inventory management is implemented to ensure continuous optimization of stock levels. The approach takes into account demand fluctuations, product turnover rates, delivery times, and market conditions, which is particularly important for pharmaceutical products characterized by expiration dates and regulatory constraints.

To evaluate the effectiveness of the model, statistical methods were applied, including variance analysis (ANOVA). The results of the analysis demonstrate that the introduction of an integrated information model leads to statistically significant improvements in key performance indicators, such as inventory turnover, order fulfillment rates, and logistics cost reduction.

The implementation of the proposed information model enables pharmacy chains to respond promptly to changes in market demand, reduce excess inventories, improve service quality, and minimize overall logistics costs. As a result, the model contributes to the formation of a more resilient and adaptive pharmacy logistics system.

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Discussion

The results of the study confirm that effective information flow management is a critical factor in improving the operational and economic efficiency of pharmacy chains. The empirical findings demonstrate that logistics performance is strongly influenced not only by physical infrastructure but also by the quality, timeliness, and integration of information flows.

The proposed logistics-based information model addresses the key challenges identified during the empirical analysis, including data fragmentation, delayed decision-making, and inefficient inventory control. By integrating information flows across all levels of the pharmacy chain, the model supports transparency and enhances managerial control over logistics processes.

Compared to traditional decentralized systems, the proposed approach offers several strategic advantages. First, centralized information management improves coordination between pharmacies and distribution centers, reducing the risk of stock imbalances and emergency replenishments. Second, real-time data availability enhances the responsiveness of pharmacy chains to changes in demand and market conditions. Third, automated order management reduces human error and supports standardized decision-making processes.

The findings of this study are consistent with current trends in supply chain digitalization and the development of integrated logistics information systems. The model contributes to sustainable development of pharmacy chains by improving resource utilization, reducing operational costs, and strengthening competitive positions in the pharmaceutical market.

Furthermore, the proposed approach has practical relevance for emerging markets, where pharmacy chains often operate under conditions of high import dependence, regulatory constraints, and volatile demand. The adaptability of the model allows it to be scaled and customized for pharmacy chains of different sizes and organizational structures.

Overall, the study demonstrates that the transition from fragmented information systems to integrated logistics-based information models is a necessary condition for enhancing efficiency and long-term competitiveness of pharmacy chains in the modern pharmaceutical market.

Conclusion

This study demonstrates that effective management of information flows based on logistics principles plays a decisive role in improving the operational and economic performance of pharmacy chains. The findings confirm that fragmented and poorly coordinated information systems significantly limit the efficiency of inventory control, order management, and logistics decision-making.

The proposed organizational information model and the methodological approach to inventory optimization provide practical and scalable tools for enhancing logistics performance in pharmacy chains. Their implementation contributes to a reduction in logistics costs, an increase in inventory turnover, and an improvement in service quality through more accurate and timely replenishment decisions. Centralized data processing and real-time monitoring enable pharmacy chains to respond more effectively to demand fluctuations and market changes.

The results of the research have high practical applicability and can be implemented in pharmacy chains of various scales, regardless of their organizational structure or market position. In addition, the developed approaches may be used in educational programs in logistics, pharmaceutical

management, and supply chain management, contributing to the training of specialists capable of operating in digitally integrated logistics environments.

Despite the achieved results, the study has certain limitations related to data availability and the scope of empirical analysis. Therefore, further research may focus on expanding the dataset, conducting longitudinal studies, and testing the proposed model in different regional and regulatory contexts. Particular attention should be given to the integration of advanced digital technologies, such as predictive analytics, machine learning, and artificial intelligence, which have the potential to further enhance demand forecasting accuracy, automate decision-making processes, and increase the adaptability of pharmacy logistics systems.

Overall, the research confirms that the transition toward integrated, logistics-based information flow management is a necessary condition for ensuring sustainable development and long-term competitiveness of pharmacy chains in the modern pharmaceutical market.

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