International Journal of Multidisciplinary and Innovative Research

ISSN(print): 3050-6883, ISSN(online): 3050-6891

Volume 03 Issue 01 January 2026

DOI: 10.58806/ijmir.2026.v3i1n08

Page No: 62-67

A Study on Reverse Logistics and Its Impact on Supply Chain Efficiency with Reference to Pharmaceutical Wholesalers and Distributors

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ABSTRACT

The role of a reverse logistics has recently become a very important part of a pharmaceutical supply chain as the number of expired drugs, recalls, damaged goods and the strict regulations regarding safety, and environmental responsibility grow. The paper examines how reverse logistics activities affect the effectiveness of pharmaceutical supply chains with a particular consideration on pharmaceutical wholesalers and distributors. The research design used was descriptive research design, in which primary data has been used based on the form of structured questionnaire conducted on 100 wholesalers and distributors, and secondly, secondary sources have been used by the researcher, including academic journals, textbooks, and industry and regulatory publications. Multiple regression analysis was carried out to analyze the collected data with the help of Jamovi statistical software.The findings of the study reveal that the regression model has a high explanatory power, as the R2 was 0.75, implying that pharmaceutical supply chain efficiency can be explained by 75 percent by the reverse logistics practices. Such essential dimensions as the effective expiry management, recall management, and safe disposal mechanisms have been detected to play an important role in improving the performance and regulatory compliance of the operations. Such negative interrelationship between intercept and reverse logistics also reflects that without efficient reverse logistic systems, the supply chain performance would be significantly impaired. On the whole, the results validate the idea that the strategic role of reverse logistics in the pharmaceutical supply chain is rather significant, and that the adoption of compact and technologically advanced reverse logistics models can enable the enhancement of the efficiency, compliance, and the long-term viability of the pharmaceutical supply chain by wholesalers and distributors.

ARTICLE DETAILS

Published On:
19 January 2026

KEYWORDS: Reverse Logistics, Pharmaceutical Supply Chain Efficiency, Wholesalers and Distributors

Available on:
https://ijmir.com

INTRODUCTION

The pharmaceutical supply chain is also essential in ensuring that medicines get to patients in a safe, efficient and within the needed time units. Since it has direct impact on the health of the population, pharmaceutical industry operates under close regulatory measures concerning the quality, safety, and environmental responsibility of its products (World Health Organization, 2010; Government of India, 2021). Traditionally, the pharmaceutical supply chain management has centered much of its attention to forward logistics operations to include sourcing, production, storage, and distribution. Over the past years, the accelerating rate at which expired, damaged, returned and recalled pharmaceutical products have however, increased focus on the value of reverse logistics actions (Rogers and Tibben-Lembke, 2001; Kumar and Putnam, 2008). Reverse logistics refers to the systematic movement of the product after consumption along the supply chain to fulfil such aims as safe disposal, recycling or recovery of residual value. In the pharmaceutical industry, they are especially complicated because improper handling of the returned medicines may cause significant threats to the health of the population and the environment (Srivastava, 2007; Kumar and Putnam, 2008). Drug sales

wholesalers and middlemen are also the key players in the management of these reverse flows, particularly concerning the expired and recalled drugs. Efficient reverse logistics is the practice that assists organizations to mitigate economic losses, meet regulatory measures, and support the objectives of sustainability throughout the pharmaceutical supply chain (Govindan et al., 2015; Guide and Van Wassenhove, 2009). As a result, it is of significant importance both to scholarly research and to practice in the pharmaceutical supply chain to analyze how the concept of reverse logistics affects the efficiency of the supply chain.

BACKGROUND OF THE STUDY

The pharmaceutical industry has witnessed a thin rise in the number of returned medications within the last couple of years, attributed to the recalls of the products, expiry, damages in transit, and changes in demand in the market. Good Sanity Good manufacturing practice (GMP) and Good distribution Practice (GDP) through strict government regulations require the pharmaceutical waste to be handled, documented, and disposed of correctly. Failure to meet these regulatory standards may result in harsh financial fines, legal proceedings and reputational loss to organizations. Pharmaceutical wholesalers and distributors are considered as the key players in the collection and such distribution of expired and returned medicines as they act as central figures between manufacturers and retail outlets. Their role would be to make sure such products are either disposed of in a safe manner or re-introduced properly as per the regulatory requirements. Poor reverse logistics systems tend to contribute to increased operations, poor inventory management and environmental hazards. It is therefore important to have an in-depth insight into the practice of reverse logistics and how it affects the efficiency of the supply chain in order to improve operational performance and sustainability in the pharmaceutical industry.

OBJECTIVE OF THE STUDY

The main objective of the study is to determine how the practice of reverse logistics, such as expired medicine, recall, regulatory compliance, and return processing affect operational efficiency, cost effectiveness and sustainability of the pharmaceutical supply chain with particular reference to the wholesaler and distributor.

LITERATURE REVIEW

Reverse logistics has become an important area of concern in the study of supply chain management because it is a strategic factor in ensuring sustainability, regulations, and competitive edge. The classic supply chains have mostly been focusing on the forward flows, whereby the products move out of the manufacturers and to the final users. Nevertheless, the growing concern about environmental impact, product recall, returns, and regulatory requirements have brought the focus to the backward flow of goods, which is known as the reverse logistics (Rogers and Tibben-Lembke, 2001).Rogers and Tibben-Lembke (2001) gave some background knowledge on reverse logistics as a process that is done in a systematic manner and involves planning, implementation as well as control of the flows of products, which are at the point of consumption to the point of origin, with a view to recovering value or disposal of the products. Their article pointed out that reverse logistics is not to be viewed as a cost center only, but as a strategic activity that can aid in the waste reduction and value creation. This school of thought has shaped much research in various industries.Companies that deal with products that are considered to be of high risks and regulations such as electronics, automotive parts, and pharmaceuticals have extra complexities in reverse logistics because of tight legal, quality, and safety regulations (Guide and Van Wassenhove, 2009). The drug expiry, drug recalls due to quality reasons and the riskiness of pharmaceutical waste are among factors in the pharmaceutical industry that explain the necessity of good reverse logistics measures (Kumar & Putnam, 2008). Contrary to most other industries, the backwardness of pharmaceutical products should be focused on the welfare of the population and the environment alongside the financial aspects.The review on the concept of reverse logistics conducted by Govindan, Soleimani, and Kannan (2015) proved that properly designed reverse logistics systems may lead to savings in costs, increased environmental performance, higher customer satisfaction, and better regulatory compliance. As they point out, decision support tools and quantitative modeling are necessary in designing effective reverse logistics networks that can handle returns, repair, refurbishments and end-of-life disposal in accordance with the sustainability goals.Kumar and Putnam (2008) also stress that mismanagement of expired or recalled drugs may result in imminent threats to population health, and regulatory fines, as well as, disruptions to supply chain processes, in the case of pharmaceuticals. Srivastava (2007) also emphasizes the importance of information technology in the reverse supply chains and adds that ERP systems, RFID tracking, and real-time monitoring make it easier to monitor, trace and control the operations. In the case of pharmaceutical wholesalers and distributors, these technologies will help in ensuring compliance, safe handling of returned products and reduce the chances of returning counterfeit or expired medicines to the market.Lastly, researchers have discussed the strategic importance of integrating reverse logistics into the larger supply chain and sustainability systems. Seuring and Muller (2008) came up with conceptual models that interconnected reverse logistics and performance of the supply chain as well as sustainable business practices. According to their findings, those organizations that consider reverse logistics as a part of the strategic plans are more likely to attain balanced economic,

environmental, and social results. All in all, the concept of reverse logistics is being viewed not as a solitary operation procedure, but as a part of the sustainable supply chain management programs and corporate social responsibility efforts.

Conceptual Model

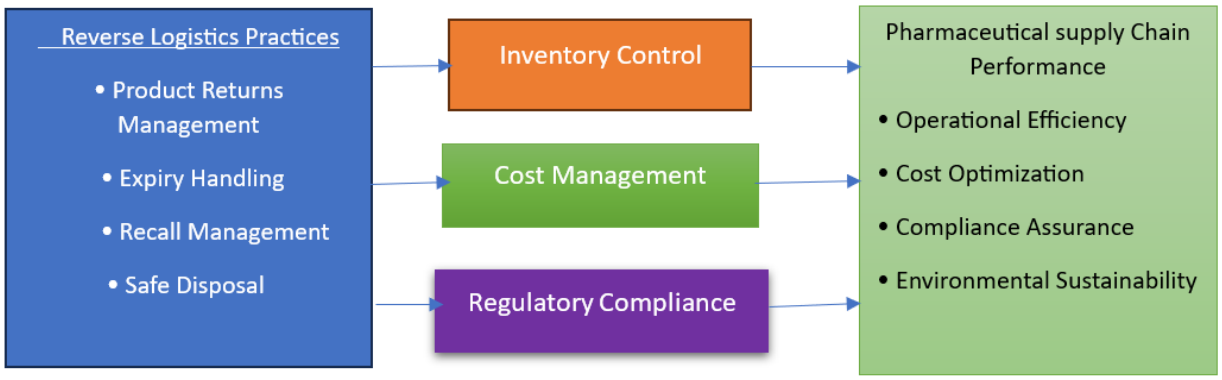

FIG: 1 CONCEPTUAL MODEL

Figure 1 represents the theoretical framework of the research paper illustrates the interdependence of the practice of reverse logistics with efficiency in pharmaceutical supply chain, in the context of operations of wholesalers and distributors. The model is based on reverse logistics theory and supply chain efficiency frameworks, which postulates that the management of reverse product flows is effective towards better operational performance, cost effectiveness, and regulatory compliance.

Pharmaceutical Supply Chain Efficiency (PSCE) is the dependent variable used in this study, it is the general efficacy of the supply chain in terms of inventory control, cost-containment, service reliability, and compliance with the pharmaceutical regulations. The independent variables are the major dimensions of the reverse logistics practices:

Product Returns Management (PR): The organized way of managing, recording, and processing returned pharmaceutical products.

Expiry Handling (EH): To identify, separate, and handle expired drugs in a timely manner to reduce wastage and to send back drugs that are out of date or are not required by the regulatory authorities.

Recall Management (RM): The ability of distributors to be responsive and efficient in the handling of product recalls in terms of traceability and action.

Safe Disposal (SD): The legally accepted and safe disposal modes of the expired, damaged, or recalled pharmaceutical products.
It is suggested that all these dimensions of reverse logistics affect the efficiency of pharmaceutical supply chains directly and positively, which lends strategic significance to the implementation of well-organized reverse logistics practices in the domain of supply chain management.

RESEARCH METHODOLOGY

The research design used in the study is descriptive and analytic design to investigate the correlation between the practice of reverse logistics and the efficiency of the pharmaceutical supply chain.

DATA COLLECTION

Primary Data: Collected using structured questionnaire to sample to pharmaceutical wholesalers and distributors.
Secondary Data: Obtained through scholarly articles, books, regulatory books and industry reports.
Sampling Method: The participants of the study were selected by convenience sampling.
Sample Size: The research gathered information on 100 pharmaceutical distributors and wholesalers.

- **Jamovi software is used for the study.**

Regression Results (n = 100)
Data Analysis:

Multiple Regression

Variable	β Coefficient	Std. Error	t-value	p-value
Constant	−0.165	0.405	−0.41	0.683
Product Returns Management (PR)	0.358	0.048	7.50	< 0.001
Expiry Handling (EH)	0.305	0.053	5.80	< 0.001
Recall Management (RM)	0.273	0.073	3.73	< 0.001
Safe Disposal (SD)	0.196	0.035	5.56	< 0.001

Multiple Regression Model

Regression Equation:

Pharmaceutical Supply Chain Efficiency = -0.165 + 0.358 **(**Product Returns Management) + 0.273 (Recall Management) + 0.196 (Safe Disposal) + ε

$$\boxed{\text{PSCE} = -0.165 + 0.358(\text{PR}) + 0.305(\text{EH}) + 0.273(\text{RM}) + 0.196(\text{SD}) + \varepsilon}$$

Where:

- PSCE = Pharmaceutical Supply Chain Efficiency
- PR = Product Returns Management
- EH = Expiry Handling
- RM = Recall Management
- SD = Safe Disposal
- ε = Error term

The sample of 100 respondents of the multiple regression analysis is statistically significant because the F-value is 33.94 ($p < 0.001$). The model describes 74.1% of the variance in the efficiency of pharmaceutical supply chain ($R2=0.741$) which indicates the combination of product returns management, expiry management, recall management and safe disposal practices is significant.The regression results indicate that **product returns management, recall management, and safe disposal** all have a positive influence on **pharmaceutical supply chain efficiency**. Product returns management shows the strongest effect ($\beta = 0.358$), suggesting that efficient handling of returned products significantly enhances overall supply chain performance. Recall management ($\beta = 0.273$) also contributes positively, indicating that well-organized recall processes help reduce disruptions and improve operational efficiency. Safe disposal practices ($\beta = 0.196$) further support supply chain efficiency by ensuring regulatory compliance and minimizing risks associated with expired or defective products. Although the intercept is negative (−0.165), it mainly serves as a statistical reference point. Overall, the findings highlight that effective reverse logistics practices play a crucial role in improving pharmaceutical supply chain efficiency.

FINDINGS

The findings of the study clearly demonstrate that **reverse logistics practices play a significant and positive role in enhancing pharmaceutical supply chain efficiency** among wholesalers and distributors. The regression results indicate that **product returns management, expiry handling, recall management, and safe disposal** are all statistically significant predictors of supply chain efficiency, collectively explaining a substantial proportion of variance ($R^2 = 0.741$). Among these factors, **product returns management emerged as the most influential variable**, highlighting the importance of systematic return processing in reducing operational disruptions and improving inventory control. Effective **expiry handling and recall management** further contribute to efficiency by ensuring regulatory compliance, traceability, and timely response to product-related risks. **Safe disposal practices** were also found to positively impact supply chain efficiency by minimizing environmental hazards and legal risks. Although the intercept value was negative, it underscores the critical insight that **absence of efficient reverse logistics systems can severely impair supply chain performance**. Overall, the study confirms that integrating well-structured and compliant reverse logistics mechanisms is essential for improving operational efficiency, sustainability, and long-term performance of pharmaceutical supply chains.

CONCLUSION

The study concludes that **reverse logistics is a critical determinant of pharmaceutical supply chain efficiency**, particularly for wholesalers and distributors operating under stringent regulatory environments. The empirical findings confirm that effective management of product returns, expiry handling, recall processes, and safe disposal significantly enhances operational efficiency,

cost control, regulatory compliance, and sustainability. The high explanatory power of the regression model indicates that reverse logistics practices account for a substantial portion of supply chain performance, emphasizing their strategic importance rather than viewing them merely as supportive or corrective activities. The negative intercept further highlights that the absence of structured reverse logistics mechanisms can adversely affect supply chain efficiency. Overall, the study reinforces the need for pharmaceutical firms to integrate technologically enabled and well-coordinated reverse logistics systems into their supply chain strategies to ensure long-term efficiency, compliance, and resilience in the pharmaceutical sector.

FUTURE SCOPE

The upcoming studies might consider more factors that determine the efficiency of pharmaceutical supply chains, including the implementation of modern technologies, the stability of suppliers, and the application of digital traceability systems. Longitudinal research can give some indication of the changing effects of reverse logistics over time, and cross-regional or cross-industry comparisons can point at context differences. The research of how safe disposal contributes to the environmental and financial advantages would serve to invest further studies in the area to enhance the perception of how reverse logistics helps not only to enhance operational performance but also to achieve sustainability goals.

REFERENCES

1) Blackburn, J. D., Guide, V. D. R., Souza, G. C., & Van Wassenhove, L. N. (2004). Reverse supply chains for commercial returns. California Management Review, 46(2), 6–22.
2) Blumberg, D. F. (2005). Introduction to management of reverse logistics and closed-loop supply chain processes. Boca Raton: CRC Press.
3) Carter, C. R., & Ellram, L. M. (1998). Reverse logistics: A review of the literature. Journal of Business Logistics, 19(1), 85–102.
4) European Medicines Agency. (2013). Good Distribution Practice of medicinal products for human use. EMA.
5) Fleischmann, M., & Van Wassenhove, L. N. (2001). Strategic framework for closed-loop supply chains. California Management Review, 43(2), 32–52.
6) Fleischmann, M., Bloemhof-Ruwaard, J. M., van der Laan, E., & van Nunen, J. A. E. E. (1997). Quantitative models for reverse logistics. European Journal of Operational Research, 103(1), 1–17.
7) Government of India. (2021). Guidelines for Good Distribution Practices (GDP) for pharmaceutical products. Ministry of Health & Family Welfare.
8) Govindan, K., & Soleimani, H. (2017). A review of reverse logistics and closed-loop supply chains. European Journal of Operational Research, 240(3), 603–626.
9) Govindan, K., Soleimani, H., & Kannan, D. (2015). Reverse logistics and closed-loop supply chain: A comprehensive review. European Journal of Operational Research, 240(3), 603–626.
10) Guide, V. D. R., & Jayaraman, V. (2000). Supply-chain management for returns. Interfaces, 30(3), 125–142.
11) Guide, V. D. R., & Van Wassenhove, L. N. (2009). The evolution of closed-loop supply chain research. Operations Research, 57(1), 10–18.
12) Guide, V. D. R., Harrison, T. P., & Van Wassenhove, L. N. (2003). The challenge of closed-loop supply chains. Interfaces, 33(6), 3–6.
13) Guide, V. D. R., Jayaraman, V., & Linton, J. D. (2003). Building contingency planning for closed-loop supply chains. Journal of Operations Management, 21(2), 145–165.
14) Kumar, S., & Putnam, V. (2008). Cradle-to-cradle: Reverse logistics strategies and practices. The International Journal of Logistics Management, 19(3), 374–387.
15) Kumar, S., Teichman, S., & Timpernagel, T. (2012). A green supply chain is a requirement for profitability. International Journal of Production Research, 50(5), 1278–1296.
16) Richey, R. G., Genchev, S. E., & Daugherty, P. J. (2005). The role of resource commitment in reverse logistics performance. International Journal of Production Research, 43(16), 3303–3320.
17) Rogers, D. S., & Tibben-Lembke, R. S. (1999). Going backwards: Reverse logistics trends and practices. Pittsburgh: Reverse Logistics Executive Council.
18) Rogers, D. S., & Tibben-Lembke, R. S. (2001). An examination of reverse logistics practices. Journal of Business Logistics, 22(2), 129–148.
19) Seuring, S., & Müller, M. (2008). From a literature review to a conceptual framework for sustainable supply chain management. Journal of Cleaner Production, 16(15), 1699–1710.

20) Sheu, J. B., Chou, Y. H., & Hu, C. C. (2005). An integrated logistics operational model. Transportation Research Part E, 41(4), 287–313.
21) Srivastava, S. K. (2007). Green supply-chain management: A state-of-the-art literature review. International Journal of Management Reviews, 9(1), 53–80.
22) Stock, J. R. (1992). Reverse logistics. California Management Review, 34(2), 55–68.
23) Stock, J. R., & Mulki, J. P. (2009). Product returns processing: An examination of practices. Journal of Business Logistics, 30(1), 33–62.
24) World Health Organization. (2010). Pharmaceuticals: Ensuring access, safety and quality. Geneva: WHO Press.
25) World Health Organization. (2014). Guidelines for medicine disposal. Geneva: WHO Press.