

## Original Research Article

## AI & Data-Driven Inventory Management for Improving Medicine Availability at Jan Aushadhi Kendras

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### Abstract:

The rapid expansion of the Pradhan Mantri Bhartiya Janaushadhi Pariyojana (PMBJP) has significantly enhanced access to affordable generic medicines across India through a growing network of Jan Aushadhi Kendras (JAKs). However, the long-term success of this network relies heavily on consistent medicine availability. Operational challenges—such as localized stockouts, inventory imbalances, and expiry-related wastage—disrupt supply chains and threaten patient access to affordable healthcare. This highlights a critical need to examine how emerging tools like Artificial Intelligence (AI) and predictive data analytics can optimize inventory management within the PMBJP framework.

The purpose of this study is to examine the potential of AI-based demand forecasting and data-driven inventory models to maximize medicine availability and improve asset turnover at JAKs. The study adopts a descriptive and analytical research design based on secondary data sourced from PMBI and PIB publications,

government reports, and peer-reviewed literature on AI applications in pharmaceutical logistics. Trend analysis, comparative evaluations, and qualitative synthesis are utilized to assess PMBJP's unique operating environment against empirical evidence from comparable health systems.

Findings from parallel healthcare settings show that AI-enabled inventory systems can reduce stockouts by 30–55%, increase inventory turnover by up to 70%, and cut expired inventory losses by 20–33%. While these figures do not represent direct empirical data from individual JAK outlets, they provide robust conceptual support for AI integration. Crucially, the study identifies PMBI's existing IT-enabled supply chain infrastructure and digital ecosystem as an ideal, mature foundation to host these future AI applications.

Future research should focus on developing and testing JAK-specific AI models using store-level sales, inventory, and localized demand data. Implementing such automated decision-support models could systematically eliminate stockouts, curb chemical wastage, and strengthen overall supply chain resilience. Ultimately, this technological transition supports more reliable public access to affordable medicines, contributing directly to a highly inclusive and sustainable public healthcare system.

**Keywords:** Jan Aushadhi Kendras, AI, inventory management, medicine availability, stockouts, PMBJP

## 1. Introduction:

Access to affordable and availability of medicines remains an important public-health concern in India. The Pradhan Mantri Bhartiya Janaushadhi Pariyojana (PMBJP), implemented by the Pharmaceuticals & Medical Devices Bureau of India (PMBI), addresses this through quality generic medicines at lower prices via Jan Aushadhi Kendras (JAKs). With more than 20,000 Kendras by 2025, the scheme has expanded substantially; however, its effectiveness depends not only on network size but also on continuous medicine availability. Studies have identified concerns related to stockouts, inventory and supply-chain management (Government of India, 2025). Meanwhile, AI, predictive analytics and digital supply-chain systems offer opportunities to improve demand forecasting and inventory efficiency (Kumar & Dhingra, 2020).

Thus, the study examines the potential role of AI and data-driven inventory management in improving medicine availability at JAKs. It has two objectives: to examine the potential impact of AI-based demand forecasting on medicine stockouts; and to assess the potential effect of data-driven inventory management on inventory efficiency and wastage reduction.

As direct evidence remains limited, the study uses secondary evidence from government sources and research on AI-enabled healthcare and pharmaceutical inventory management.

At present, there is a limited integration of PMBJP inventory management with the help of AI. This study contributes by integrating these two strands and developing a context-specific conceptual assessment of AI-enabled inventory management for JAKs. It also examines PMBI's IT-enabled supply chain, fast-moving-product monitoring and the Jan Aushadhi Sugam App as components of the broader digital ecosystem.

The paper is organised as follows: **Section 2** presents the objectives, hypotheses and research gap. **Section 3** reviews relevant literature on PMBJP, pharmaceutical inventory challenges and AI-driven inventory management. **Section 4** explains the methodology, data sources, analytical framework and governance architecture. **Section 5** presents the findings and analysis, including PMBJP growth, inventory challenges, AI evidence, the Sugam App and

potential AI applications at JAKs. **Section 6** presents the conclusion, implications and recommendations, followed by limitations and future research scope.

## 2. Objectives and Hypotheses

### 2.1 Objectives

- i. To examine the potential of AI-based demand forecasting to reduce medicine stockout rates at Jan Aushadhi Kendras.
- ii. To assess the potential role of data-driven inventory management in improving inventory efficiency and reducing expiry-related losses at Jan Aushadhi Kendras.

### 2.2 Hypotheses

#### Hypotheses 1:

**H<sub>01</sub>:** AI-based demand forecasting does not significantly reduce medicine stockout rates at Jan Aushadhi Kendras.

**H<sub>11</sub>:** AI-based demand forecasting significantly reduces medicine stockout rates at Jan Aushadhi Kendras.

#### Hypotheses 2:

**H<sub>02</sub>:** Data-driven inventory management does not significantly improve inventory turnover or reduce expiry-related losses at Jan Aushadhi Kendras.

**H<sub>12</sub>:** Data-driven inventory management significantly improves inventory turnover and reduces expiry-related losses at Jan Aushadhi Kendras.

**Note:** Since the study is based entirely on secondary data and does not involve primary experimentation or statistical comparison between AI-enabled and conventional JAKs, the hypotheses are evaluated conceptually through analysis of existing evidence rather than statistically tested in the present study.

## 3. Review of Literature

**Thawani, Mani, and Upmanyu (2017)** identified poor supply-chain coordination, inadequate local awareness, and limited support from healthcare professionals as key constraints undermining the operational efficiency of the Jan Aushadhi Scheme.

**Lavtepatil and Ghosh (2022)** conducted an empirical evaluation of 11 PMBJP pharmacies across the Mumbai and Palghar districts and discovered that only 47% of essential medicines were consistently available, with roughly 50% of unavailable drugs in Mumbai and 42% in Palghar experiencing stockouts lasting between three to six months, pointing directly to persistent procurement, distribution, and inventory bottlenecks.

**Kaur and Prakash (2025)** demonstrated the efficacy of deep reinforcement learning for intelligent inventory replenishment, utilizing real-time parameters such as demand fluctuations, stock levels, order cycles, and lead times.

**Ahmadi et al. (2022)** applied Q-learning and Deep Q-Networks to perishable pharmaceutical inventories, successfully achieving high service levels while minimizing expiry-related losses.

**Kushwaha et al. (2025)** provided empirical evidence from healthcare settings showing that predictive AI-driven inventory frameworks can reduce stockouts by up to 42%, decrease expired stock value by 33%, and significantly enhance annual inventory turnover.

## 4. Research Methodology

### 4.1 Research Design and Data Sources

**Research Design:** The study adopts a descriptive and analytical research design based entirely on secondary data.

**Data Source:** PMBI, Department of Pharmaceuticals, PIB, academic literature, policy documents, supply-chain documents, procurement documents.

**4.2 Variables:** stockout rate, expiry losses, demand forecasting, predictive replenishment, lead time.

### 4.3 Analytical Framework and Governance Architecture

- a) **Inputs** like sales, inventory, demand and replenishment data,
- b) **AI and analytics** include forecasting, stockout/expiry-risk detection, predictive replenishment as well as optimisation of inventory, and
- c) **Outputs** include better medicine availability, inventory utilisation and reduced stockouts and expiry losses.

PMBI already operates an IT-enabled supply-chain system for stock monitoring, demand forecasting and replenishment, with digitisation of demand estimation underway. The study therefore proposes centralised AI integration through PMBI, not independent implementation by JAKs. This is a proposed paper, not an existing PMBJP AI system based statistical data.

### 4.4 Methods of Data Analysis and Limitations

This study qualitatively and comparatively analyzes JAK growth, inventory challenges, and digital mechanisms, using external data as secondary evidence. Lacking direct, JAK-specific AI data, it offers an evidence-based conceptual assessment of AI's potential impact rather than a statistical measure of actual outcomes.

## 5. Findings and Analysis

### 5.1 Growth and Performance of Jan Aushadhi Kendras

**Table 1:** Growth of Jan Aushadhi Kendras and Sales Performance

| Period   | Functional/Operational JAKs | Sales at MRP Value (₹-Cr) | Status/Reference                 |
|----------|-----------------------------|---------------------------|----------------------------------|
| 2022–23  | —                           | 1,235.95                  | Reported annual sales            |
| 2023–24  | —                           | 1,470.00                  | Reported annual sales            |
| 2024–25  | 15,403                      | 2,022.47                  | JAK count as of 31 March 2025    |
| 2025–26  | 18,646                      | 2,252.19                  | JAK count as of 28 February 2026 |
| Mid-2026 | 20,149                      | 474.40                    | Partial-year figure              |

**15,403 JAKs were reported as of 31 March 2025; 18,646 as of 28 February 2026; 20,149 as of 30 June 2026. Sales for 2026–27 are partial-year sales.**

**Interpretation:** PMBJP has witnessed substantial expansion of JAKs in both geographical reach and medicine sales. The number of JAKs increased from 15,403 as of March 2025 to 17,610 by November 2025, 18,646 by February

2026 and 20,149 by 30 June 2026. Sales at MRP value increased from ₹1,235.95 crore in 2022–23 to ₹1,470.00 crore in 2023–24, ₹2,022.47 crore in 2024–25 and ₹2,252.19 crore in 2025–26. Sales of ₹474.40 crore were recorded during FY2026–27 up to 30 June 2026.

The growth in Kendra coverage and sales reflects PMBJP's expanding scale; however, these aggregate figures do not ensure uniform medicine availability. Therefore, inventory and supply-chain performance require separate assessments.

## 5.2 Inventory and Medicine Availability at JAKs.

**Table 2:** Inventory Concerns and Existing PMBJP Measures

| Aspect                      | Evidence / Existing Measure                                                                       |
|-----------------------------|---------------------------------------------------------------------------------------------------|
| Medicine availability       | Surveyed essential-medicine availability in the Mumbai–Palghar study was 47%                      |
| Stockout duration           | Around 50% of unavailable medicines in Mumbai and 42% in Palghar were out of stock for 3–6 months |
| 200-high-demand medicines   | Stocking has been incentivised since September 2024                                               |
| 400-fast-moving products    | Regularly monitored and demand forecast on an ongoing basis                                       |
| Forecasting                 | Steps taken to digitise forecasting and augment procurement through automation                    |
| Supply-chain infrastructure | End-to-end IT-enabled system with five warehouses and 41 distributors                             |

**Source:** Compiled by the authors from BMC Health Services Research (2022) and Press Information Bureau (PIB), Government of India (2026).

**Interpretation:** Medicine availability remains a localized operational challenge rather than a universal shortage, as seen in a Mumbai-Palghar study where surveyed essential medicine availability was 47%, with long-term stockouts varying by location. To optimize store-level forecasting and replenishment across its 5 warehouses and 41 distributors, PMBI actively monitors 400 fast-moving items, automates digitized procurement, and provides incentives for stocking 200 common medicines.

## 5.3 Evidence on AI and Data-Driven Inventory Management

**Table 3:** Selected Evidence on AI-Enabled Inventory Management

| Study / Evidence         | Setting                     | Key Reported Outcome                                                                     |
|--------------------------|-----------------------------|------------------------------------------------------------------------------------------|
| Kushwaha et al. (2025)   | Hospital pharmacy           | Stockouts –42%; turnover 5.1→6.4 turns/year; expiry value –33%; emergency purchases –27% |
| Deependra Rastogi (2026) | Pharmaceutical supply chain | Stockout levels reduced by approximately 18–20%                                          |
| K. C. Obiezue (2024)     | Medicine inventory          | Expiry wastage reduced substantially through predictive alerts and demand forecasting    |

**Note:** These are findings from comparable settings and are not direct empirical results for JAKs.

**Source:** Compilation based on Kushwaha et al. (2025) and other multiple selected studies on AI-enabled pharmaceutical inventory management, AI-based demand forecasting, and expiry management.

**Interpretation:** Evidence from the healthcare sector demonstrates that AI-based forecasting, predictive inventory systems, and real-time monitoring significantly optimize logistics performance. A landmark study by Kushwaha et

al. (2025) across three tertiary-care hospitals revealed a 42% drop in stockouts, a 33% reduction in expired stock value, a 27% decline in emergency purchases, and an increase in annual inventory turnover from 5.1 to 6.4 turns. Broader sector data corroborates these trends, highlighting stock out reductions of up to 55% and inventory turnover gains reaching 70%. These metrics are directly relevant to Jan Aushadhi Kendras (JAKs), as AI interventions target their core operational Key Performance Indicators: stockouts, asset utilization, demand forecasting accuracy, and expiry losses

#### 5.4 Linking AI-Driven Inventory Management to JAKs

- a) **Predictive Inventory Management:** AI-backed system can help anticipates stockouts before inventory reaches critical thresholds specifically targeting the 400 fast-moving medicines monitored by PMBI at the same time it can also help in identifying slow-moving items to optimize capital efficiency and turnover.
- b) **Proactive Expiry-Risk Management:** AI-driven system can analyze stock age, historical demand, and product transit speeds to flag medicines nearing expiry, enabling timely and smooth redistribution of stock or prioritized dispensing.
- c) **Centralized Integration:** Deploying AI driven inventory management at PMBI level can help individual Jan Aushadhi Kendras to implement this technology in a unified manner.
- d) **Data Optimization:** It will also help leverages existing transaction records, store-level sales, and real-time replenishment data already captured by the PMBJP IT-enabled supply chain.
- e) **Automated Decision Support:** It can help in identifying real time field data into outlet-specific demand forecasts, expiration warnings, and dynamic replenishment alerts to guide procurement and logistics decisions across the network.

*Note: This is a **proposed conceptual architecture** and should not be interpreted as an existing centralised AI system implemented by PMBI.*

#### 5.5 Role of the Jan Aushadhi Sugam App

**Table 4:** Sugam App and Its Relevance to Inventory Management

| Function                      | Description                                                                      | Relevance                                 |
|-------------------------------|----------------------------------------------------------------------------------|-------------------------------------------|
| Locate JAKs                   | Helps users identify nearby Kendras                                              | Improves accessibility                    |
| Medicine search               | Provides medicine-related information                                            | Improves awareness                        |
| Price information             | Supports understanding of affordable generic medicines                           | Strengthens consumer engagement           |
| Kendra information            | Provides information about Kendras                                               | Facilitates access                        |
| Potential demand intelligence | Aggregated search information could complement sales data, subject to governance | Potential future input for AI forecasting |

**Interpretation:** The Jan Aushadhi Sugam App serves as a consumer-facing digital tool that helps users locate nearest stores, verify generic medicine availability, and compare prices with branded alternatives. While not an AI-based inventory system itself, its search data on consumer requirements could potentially complement future warehouse sales and inventory data to improve localized demand forecasting

## 5.6 Comparative and Feasibility Assessment

The existing PMBJP system already provides a strong digital foundation required for gradual AI integration. Rather than replacing the existing supply chain, it is suggested that AI could function as an analytical layer over existing sales, inventory, demand and replenishment information.

**Table 5:** Existing and AI-Enabled Inventory Management

| Dimension                 | Existing JAK Context                                           | AI-Enabled Approach                           | Potential Implication          |
|---------------------------|----------------------------------------------------------------|-----------------------------------------------|--------------------------------|
| Demand forecasting        | Demand estimation and historical information                   | Machine-learning/time-series forecasting      | More responsive replenishment  |
| Stockout management       | Stock-position monitoring and 400-product monitoring           | Predictive stockout alerts                    | Improved availability          |
| Inventory turnover        | Existing procurement and replenishment                         | Demand-pattern and slow-moving-stock analysis | Better inventory utilisation   |
| Expiry management         | Existing stock monitoring                                      | Expiry-risk prediction and alerts             | Lower expiry losses            |
| Decision support          | Stock reviews and demand information                           | Predictive dashboards and recommendations     | Proactive decisions            |
| Supply-chain coordination | Warehouses, distributors and JAKs connected through IT systems | Integrated AI analytics                       | Better supply-demand alignment |

## 5.7 Conceptual Evaluation of Hypotheses

**Table 6:** Summary of Findings in Relation to Objectives and Hypotheses

| Objective / Hypothesis                                                                                                      | Key Evidence                                                                                                     | Interpretation                                                       |
|-----------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|
| <b>Objective 1:</b> Examine the potential of AI-based forecasting to reduce stockouts                                       | PMBI forecasts demand for 400 fast-moving products; comparable AI studies report substantial stockout reductions | AI forecasting has potential to improve availability                 |
| <b>H<sub>1</sub>:</b> AI-based demand forecasting → lower stockout rates                                                    | Evidence from comparable healthcare settings supports the relationship                                           | Conceptually supported; not statistically tested for JAKs            |
| <b>Objective 2:</b> Assess the potential of data-driven inventory management to improve efficiency and reduce expiry losses | Comparable studies report improved turnover and lower expired inventory                                          | Data-driven management has potential to improve inventory efficiency |
| <b>H<sub>2</sub>:</b> Data-driven inventory → higher turnover and lower expiry losses                                       | Comparable healthcare/pharmaceutical evidence supports the expected relationship                                 | Conceptually supported; not statistically tested for JAKs            |

**H<sub>1</sub>: AI-based demand forecasting is associated with lower medicine stockout rates at JAKs:** Supported conceptually by healthcare sector evidence showing significant stockout reductions following predictive interventions, alongside PMBI's ongoing tracking of 400 fast-moving products. However, the exact statistical magnitude at JAKs cannot be empirically established.

**H<sub>2</sub>: Data-driven inventory management is associated with higher inventory turnover and lower expiry-related losses at JAKs:** Supported conceptually by external research reporting optimized stock turnover and reduced expiration rates, validating the relevance of predictive logistics to JAK operations.

## 6. Conclusion

This study evaluates the potential of Artificial Intelligence (AI) and data-driven inventory management to improve medicine availability at Jan Aushadhi Kendras (JAKs) under PMBJP, with the help of secondary data from government reports, PIB releases, programme-level information and published research available online. The result shows that there is a rapid expansion of the JAKs. The increased network has increased the importance of effective demand estimation, stock monitoring, replenishment and supply-chain coordination. The empirical data from healthcare and pharmaceutical areas shows that AI-enabled inventory systems can reduce the amount of stockout medicines, improve the turnover of inventory and reduce the losses related to expired medicines. PMBI already operates an IT-enabled supply-chain management system which involves stock-positioning, demand forecasting and timely replenishment, there are 400 fast-moving products which are regularly monitored and demand estimation is being digitised. The existing infrastructure thus lays a foundation for integration of advanced analytics through PMBI rather than requiring individual Kendras to independently adopt the complicated system of AI. The Jan Aushadhi Sugam App can further integrate with the AI infrastructure along with the function of locating Kendras, searching medicines and comparing prices. The findings conceptually support both hypotheses; however, there is no evidence of AI impact at JAKs.

## 7. Implications and Recommendations

For better functioning of PMBJP Scheme, AI-driven demand forecasting can strengthen the existing monitoring of fast-moving medicine, improve procurement and replenishment planning. Inclusion of AI at Kendra-level demand can also help better allocation, re-distribution and stock balancing. More information can be generated about the stock-outs, and the alert of soon-to-be expired medicine, predictive reorder-point and safety-stock recommendations based on demand variability, enabling inter-Kendra data sharing for stock redistribution can also support better information at inventory levels. From Policy point of view, the potential of AI can also be integrated into existing IT-enabled supply-chain system, training personnel to interpret AI-generated forecasts and alerts, inventory turnover and expiry-loss percentage data can appropriately improve medicine availability, reduce avoidable wastage and strengthen resource utilisation.

## 8. Limitations and Future Scope

The limitation of the study lies in its reliability on secondary data. As a result, it does not provide any evidence from Jan Aushadhi Kendras which helps to measure the actual impact of the use of AI on stockouts of medicine, inventory turnover or expiry related losses. Thus, AI-driven inventory management with respect to PMBJP still remains unexplored. Whereas several AI driven outcomes are extracted from hospital pharmacies, private pharmacies, pharmaceutical supply chains. Another major limitation also arises from difference in definitions, measurement periods, methodologies and indicators across secondary sources. Moreover, the conceptual framework of centralized AI-driven inventory system still requires practical validation.

Thus, future studies must take Jan Aushadhi Kendras and compare the pre- and post-AI driven inventory management using measurable indicators such as stockout rate, fill rate, inventory turnover, expiry-loss percentage,

forecasting accuracy and replenishment time. The future study can also evaluate the integration of PMBI sales and data of inventory with the help of Jan Aushadhi Sugam App which would help the PMBJP to demonstrate the actual effectiveness, scalability and cost-effectiveness of AI-enabled inventory management.

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