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Research Paper

Assessing user perspectives and debottlenecking of supply chain management for E-Aushadhi and FPLMIS in the Gaya district of Bihar- a cross-sectional study

Rajesh Sharma[1*], Mansi Rajput[2], Dr. Anish Sinha[3]
[1*,2]Masters of Public Health, Indian Institute of Public Health Gandhinagar, Gujarat, India.
[3]Registrar & Associate Professor, Indian Institute of Public Health Gandhinagar, Gujarat, India.

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ABSTRACT

Background: The supply chain is the network or process through which goods, equipment, and commodities are delivered from the manufacturer to the end users, i.e., customers. In Bihar, all health-related commodities except vaccines & family planning commodities are procured by BMSICL i.e., Bihar Medical Services & Infrastructure Corporation Limited. The BMSICL procured medications and commodities using an open bidding mechanism on a quarterly basis. The Bihar government's LMIS system comprises DVDMS (E-Aushadhi) & FP-LMIS.
Objective: To assess & understand the Field Level Workers' user perspectives on E-Aushadhi and FPLMIS and their challenges in the Gaya region of Bihar. Also, to understand & identify supply chain bottlenecks and potential alternatives.
Methods: It is a cross-sectional mixed method study conducted in the 7 randomly selected blocks in the Gaya district of Bihar. The sample size of the quantitative interview is calculated to be 100 and more over 8 In-Depth interviews with the Pharmacist at block and district level facilities and warehouse. The data analysis was done by the statistical software like SAS, Atlas.Ti and MS Excel.
Results: The utilization rate of the E-Aushadhi and FPLMIS was found to be 79% and 10% respectively among the ANMs. They encounter many challenges like lack of basic and comprehensive trainings, availability of transportation and dual system entry of the drugs. There are the various challenges faced by the pharmacist at facility level which include getting the late supply of the drugs, receiving counterfeit medicines, unavailability of storage units and many more.
Conclusion: The end users were satisfied with the introduction of this system but on the other hands they encounter various challenges in the same. To overcome these challenges, the government should focus on capacity building and maintaining system strictness along with the proper training and availability of the trained staff.

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Corresponding Author:
Rajesh Sharma
Masters of Public Health, Indian Institute of Public Health Gandhinagar, Gujarat, India.
Email: rajshrm1998@gmail.com

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1. INTRODUCTION

1.1 Supply Chain Management in Healthcare and its Role

According to the WHO, one of the six building blocks of the health system is medicines, vaccines, and technologies, which focuses on ensuring equitable access to essential medical products, vaccines, and technologies of assured quality, safety, efficacy, and cost-effectiveness, as well as their scientifically sound and cost-effective use. This will not be achievable without an adequate supply network [1]. Supply chain management is essential to the efficient and successful delivery of healthcare services. It involves organizing a variety of processes, including procurement, inventory management, transportation, and distribution, that ensure the timely and cost-effective delivery of healthcare products and services.

1.2 Supply Chain System in State Health Society, Bihar

According to the [2], the state's supply chain management system includes purchasing, storage, transportation, and distribution of essential medications and medical supplies. Bihar's State Health Society (SHS) has put in place a comprehensive supply chain management system to ensure the timely and efficient delivery of important medications and medical supplies to healthcare institutions throughout the state. To promote openness and efficiency in the procurement process, BMSICL has used new technologies such as the e-tendering system, online procurement site, and e-auction. The supply chain system of BMSICL has been critical in tackling healthcare difficulties in Bihar, such as shortages of important pharmaceuticals and medical supplies [3]. The process chart in the Figure 1 is depicting the supply chain management by the nodal procurement agency of healthcare commodities in Bihar i.e., BMSICL.

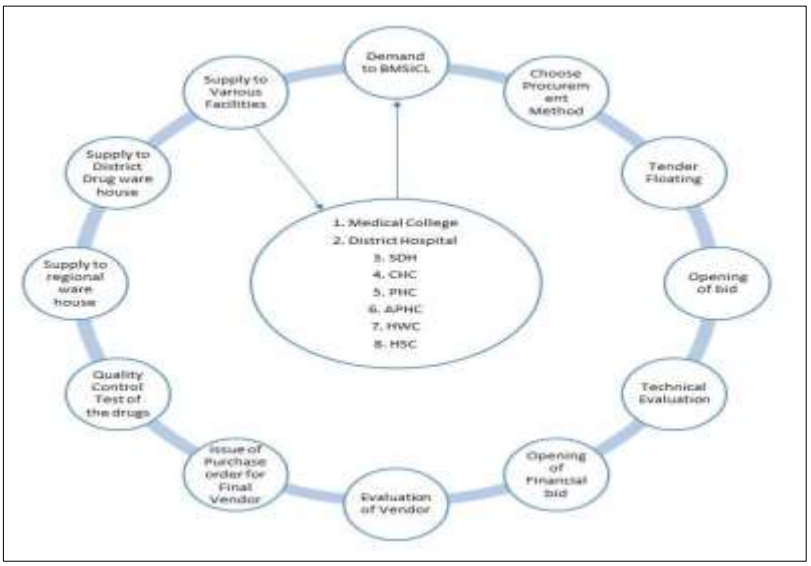

Figure 1. Process of Supply Chain in Bihar

1.3 Overview of the E-Aushadhi

E-Aushadhi is a web-based programmed created by the Government of India's Ministry of Health and Family Welfare to provide an efficient and effective manner of managing the country's drug and pharmaceutical supply chain. By digitizing the supply chain process, the system offers to provide transparency, accountability, and greater governance to medication delivery. It enables online tracking of medicine inventory, procurement, distribution, and patient dispensing. E-Aushadhi also monitors stock levels, expiry dates, and medication consumption trends in real time, reducing waste and assuring timely supply of essential medicines (MoHFW, 2018).

Presently, in Bihar, the E-Aushadhi system is utilized for centralized procurement, stock management, and medicine distribution up to the level of the state's medical colleges and hospitals, as well as the three BMSICL warehouses located in Purnea, Muzaffarpur, and Fatuha. It sends out warnings once the minimum stock level of any medicine is exceeded. The system may provide reports on pharmaceuticals that are about to expire in the next 90 and 180 days, allowing the necessary action to be taken at the right time. E-Aushadhi indent process is the bottom to up approach from the field level workers Auxiliary Nurse and Midwife (ANMs).

The procedure begins with the BMSICL acquiring medications from vendors and storing them in the BMSICL warehouse. The medications are subsequently delivered to various health facilities around the state via a process that includes requisition, approval, dispatch, and reception. The drugs are subsequently stored in BMSICL warehouses for quality assurance, where they are examined and tested. Once authorized, medicines are uploaded to the E-Aushadhi website. The medicines are then distributed to other medical facilities around the state based on demand and availability. The E-Aushadhi portal allows health facilities to submit medicine orders, while BMSICL guarantees that the orders are filled as soon as possible. The E-Aushadhi platform monitors the entire process in real time [4].

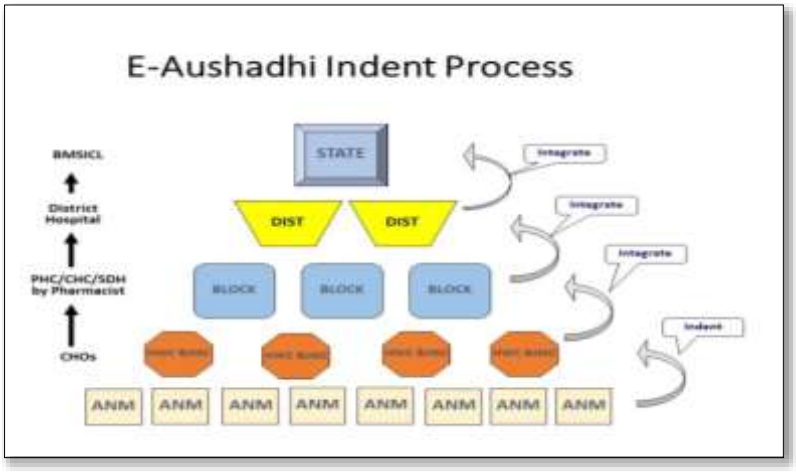

Figure 2. Process of Indenting in E-Aushadhi Portal

1.4 Overview of the FPLMIS

Ministry of Health & Family Welfare has created a user-friendly FP-LMIS application. It is a unified computerized programme that was created to manage and administer Family Planning commodities at all levels. The application calculates annual demand, enables online ordering, distribution, and stock management, and provides critical information on stock outs, overstock, expired, and damaged stock to decision makers in the form of reports and graphs to aid in the monitoring of the FP commodities supply chain system [5].

FPLMIS is a shorthand that stands for Family Planning Logistics Management Information System. It is a web-based supply chain management system intended to ensure that family planning goods are consistently available in Bihar's healthcare facilities. The State Health Society of Bihar uses the FPLMIS to monitor and manage the supply chain of family planning supplies [6].



Figure 3. Process of Supply Chain of the FPLMIS

2. METHODOLOGY

2.1 Study Design

A Cross-sectional study using a mixed method approach was conducted in the Gaya district of Bihar. Two different sets of questionnaires were used to survey. The target population includes ANMs, who will be surveyed using a semi structured questionnaire. Moreover, qualitative in-depth interviews were taken with supply chain management stakeholders that are store-in-charge/pharmacists at the block level and store-in-charges at the district level. based on the study's objectives, a semi-structured questionnaire was created. The questionnaire includes both closed-ended and open-ended questions to collect quantitative and qualitative data about user perspectives, difficulties faced, and potential bottlenecks in supply chain management by ANMs. The questionnaire was pre-tested and modified based on feedback before its actual administration [7].

A qualitative questionnaire was prepared for the in-depth interviews of the Pharmacists/ Store In-charge of the facility. The questionnaire includes 24 open-ended questions in order to collect qualitative data about socio demographics, user perspectives, difficulties faced, and potential bottlenecks in supply chain management by Pharmacists/ Store In charge [8].

2.2 Sample Size

The sample size was determined using the prevalence rate of E-Aushadhi app usage by ANMs from one of the Care, India studies done in 2021 in Bihar. The utilization rate was discovered to be 93% from the study. The formula used to drive the sample size is $n = Z^2 \times p \times \frac{(1-p)}{e^2}$

The sample size will be 100 for the study which includes 100 ANMs.

Moreover, 6 in-depth interviews were conducted with store in-charges/pharmacists at the block level in the PHC/CHC/SDH and 2 in-depth interviews were conducted with store-in-charges at the district hospital (DH) and district drug warehouse (DDW). A total of Eight IDIs were planned [9].

2.3 Sampling Technique

The approach to sampling was developed to ensure that a representative sample of stakeholders participating in the study was obtained. Multistage random sampling was used to conduct the study. The blocks were selected using quota sampling which involves selecting a sample that matches specific criteria or quotas to ensure that certain characteristics are represented in the sample. Gaya district has 24 blocks [10], which were categorized into three categories/quotas: rural blocks, mixed blocks, and blocks in the District Drug Warehouse sub-division. Gaya includes seven blocks in the district drug warehouse sub-division, 14 rural blocks, and 3 mixed blocks [11]. Using the proportional allocation approach, 33.33% of the blocks were chosen at random from each group [12], resulting two blocks in the district drug warehouse sub-division, four blocks from the rural category, and one block from the mixed category [13].

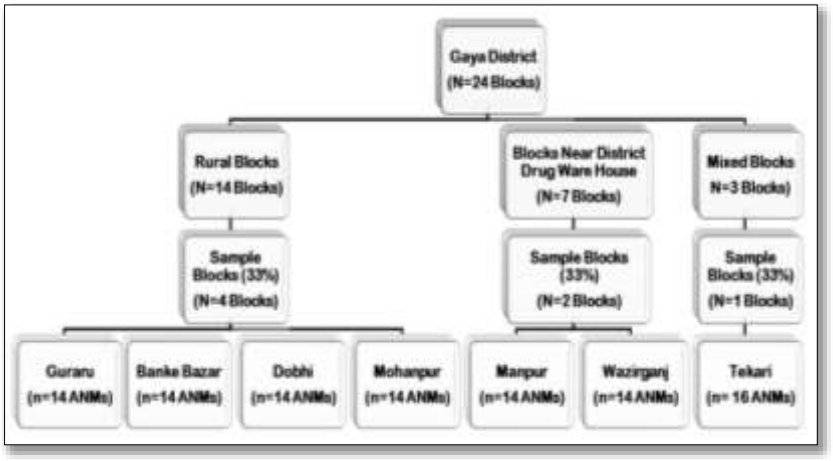

Figure 4. Sampling Frame (Quota Sampling and Proportional Allocation)

ANMs was selected using simple random technique from the list of ANM posted in each block of the district.

2.4 Inclusion and Exclusion Criteria(s)

2.4.1 Inclusion Criteria

1. ANMs who have finished their basic training and have worked at the facility or outreach for at least one year.
2. At the block Level, Pharmacist and Store in Charge of the facility
3. At the District Level, Pharmacist & Store In charge.

2.4.2 Exclusion Criteria

- ANMs whose working experience is less than 1 year or have not completed the training will be excluded.
- At the District Level, Pharmacist & Store In charge, whose work experience is less than 6 months or have not completed his/her training.

2.5 Data Collection

To completely comprehend the user views and supply chain management difficulties, a combination of quantitative and qualitative data collecting approaches was chosen for this cross-sectional study.

I gathered quantitative data by submitting semi-structured questions using Kobo Toolbox to healthcare professionals, including ANMs. The surveys were created to gather data on their opinions, problems, and experiences with using E-Aushadhi and FPLMIS [14].

Select individuals were interviewed in-depth to get the qualitative data. Pharmacy professionals/ Store In charge at the block and district levels participated in the interviews and discussions.

2.6 Data Analysis

It involved a comprehensive examination of the collected data to derive meaningful insights and draw conclusions. The quantitative analysis of the collected data was done by using SAS and Excel Software. The data mainly consist the categorical variables. To summarize and characterized the features of the variables under consideration, descriptive statistics was used. To give an entire overview of the data, measures such as mean, median, standard deviation, and percentages of the data were generated during the analysis. This aided in analyzing the core trends. The qualitative analysis of the in-depth interviews was done using Atlas Ti Software. Content analysis was used to analyze the qualitative data acquired through interviews or open-ended questions. To capture important points and patterns,

transcripts were coded, categorized, and themes were found in the Atlas Ti. This helps in supporting the findings, quotes, and extracts from participants [15].

3. RESULTS AND DISCUSSION

3.1 User Perspective & Challenges of the ANMS Using E-Aushadhi

In the Gaya district of Bihar, 71% of ANMs received training on the E-Aushadhi apps, with 88% demonstrating that they required additional training to use the E-Aushadhi programme. When asked why they did not receive training, the majority of ANMs stated that no training was provided at their institutions or other training locations [16].

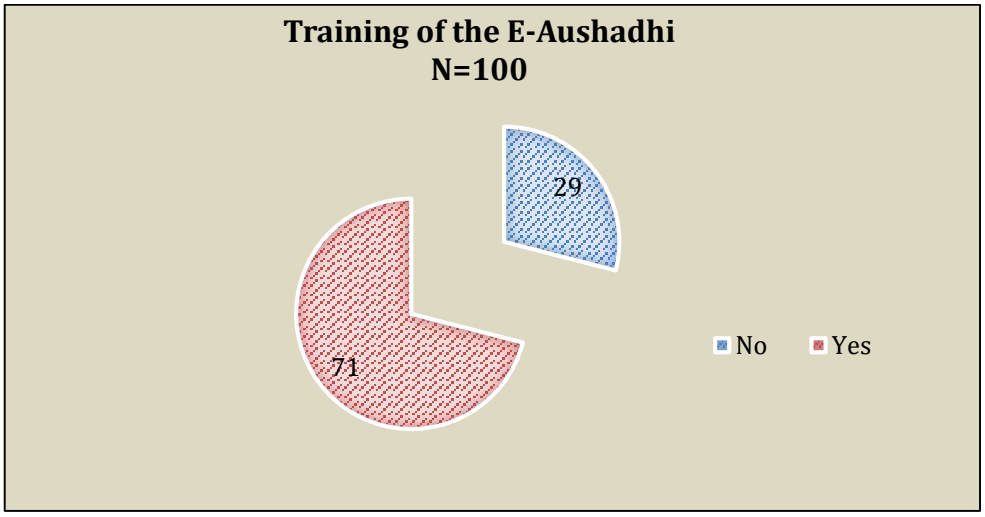

Figure 5. 2d Pie Chart Representing the Percentage of the ANMS who Received Training of the E-Aushadhi

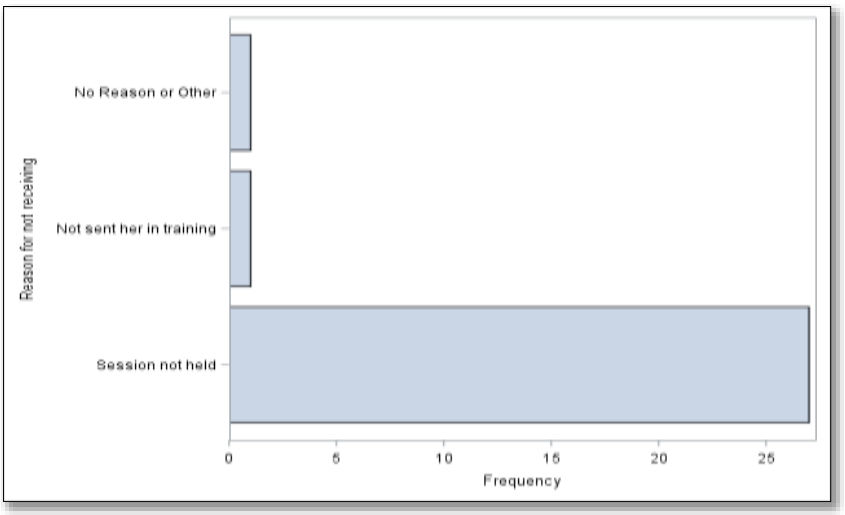

Figure 6. 2D Bar Graph Depicting the Reasons for not Receiving the Training

The proportion of ANMs who used the E-Aushadhi Portal in the Gaya District of Bihar was determined to be 79%, i.e., 79% of ANMs demanded and received medications using the E-Aushadhi Portal, whereas 21% demanded and received medicines using the offline mode. In the recent three months, all 79% responded ANMs used the E-Aushadhi platform to indent drugs. When asked whether these ANMs indented medicine by themselves or with the help of others, 57% said that they had indented the drugs by themselves using the application via Tablet or Smartphone, while 43% still required the assistance of others in the indenting procedure of the drugs or medicines [17].

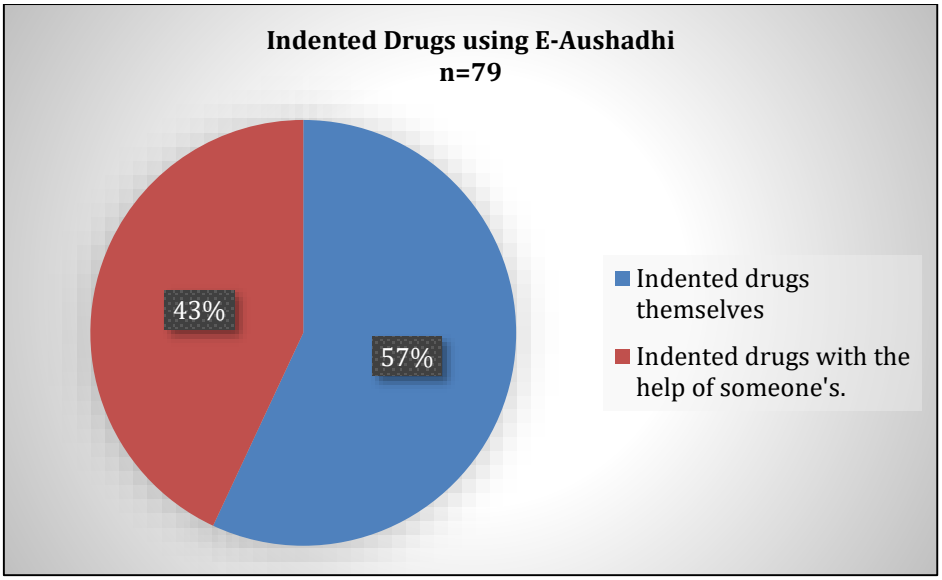

Figure 7. 2d Pie Chart Representing the Percentage of Means of Indenting the Drugs by ANMS Using E-Aushadhi Portal

ANMs who indented medicines over the previous three months asked about "whether all of the drugs are available in the portal or not?" Approximately 77% of ANMs stated that all drugs are not available in the application and that they must request or demand them via offline mode. Because these medications are not customizable in the E-Aushadhi portal, they will be unable to enter all drugs in the E-Aushadhi site.

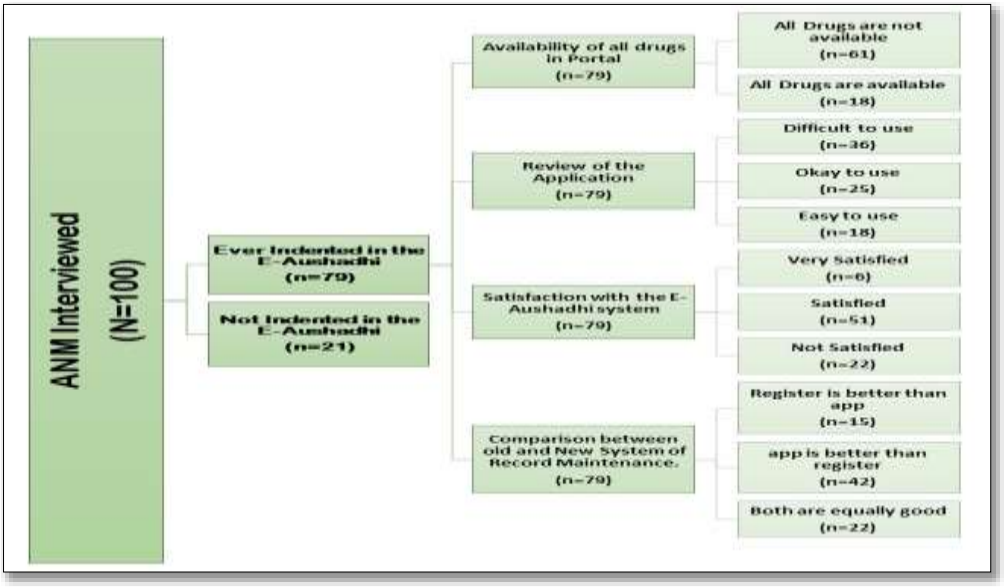

Figure 8. Descriptive Depiction of the Data on the User Satisfaction of the ANMS using E-Aushadhi Portal

The ANMs who are working at the E-Aushadhi portal answered the question on the level of The ANMs who work at the E-Aushadhi portal responded to a question about their degree of satisfaction with the new supply chain management system. Approximately 7% of ANMs are extremely or highly satisfied with the new demand and supply chain system action, while 65% replied "satisfied" in response to the degree of satisfaction. The majority of ANMs answered in the positive. However, 28% of ANMs in the district are not satisfied or unsatisfied with the newly implemented supply chain framework.

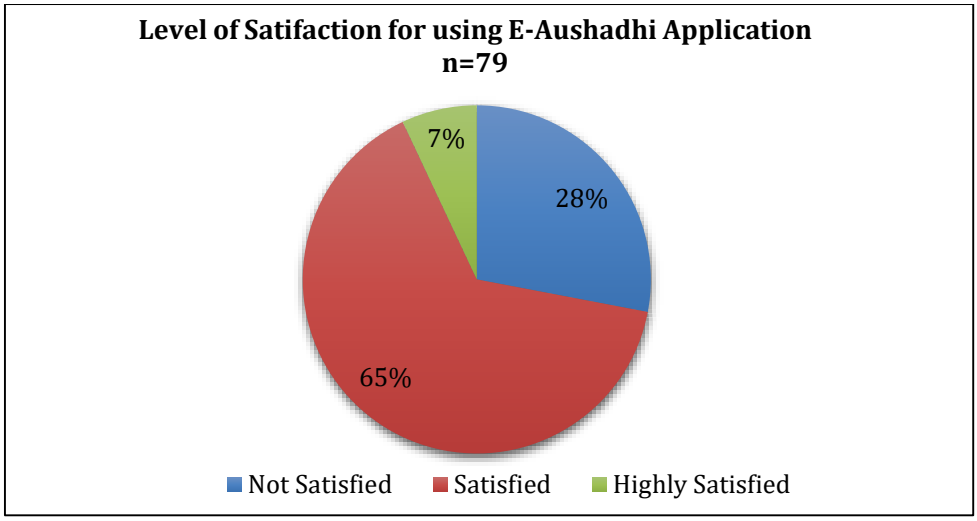

Figure 9. 2d Pie Chart Depicting the Level of Satisfaction Feels by the ANMs after using E-Aushadhi Application

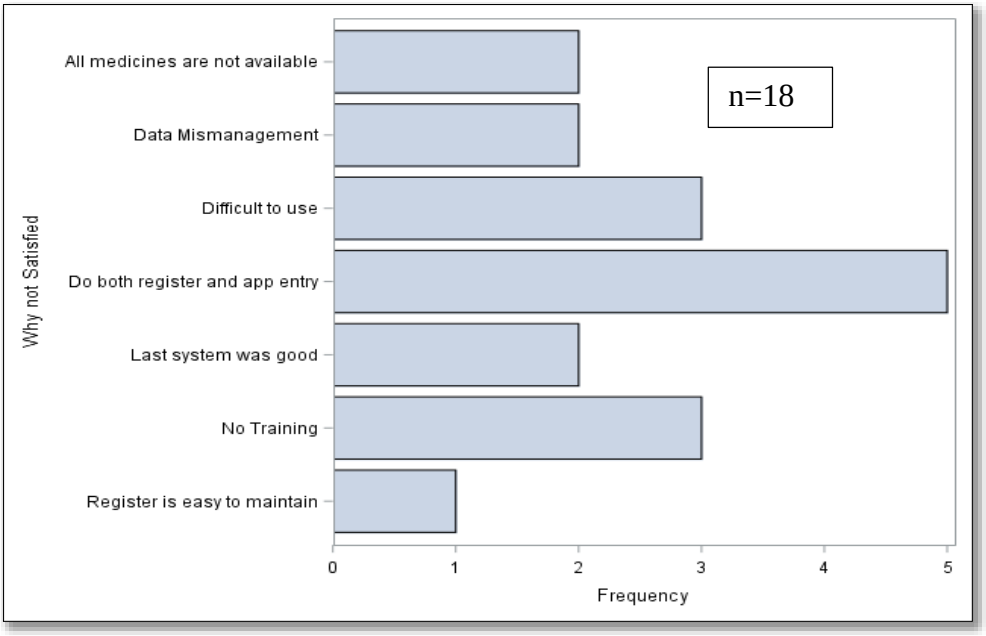

Figure 10. 2d Bar Graph Interpreting the Reason for the Dissatisfaction in the Usage of the Application by ANMS

The user satisfaction involves a comparison of the previous demand and issues system, in which ANMs had to maintain their registers and demand monthly through offline mode, and the new E-Aushadhi system, in which all ANMs may identify and manage inventories in the programme for real time monitoring. When asked whether the previous supply chain management system was better than the new one, approximately 53% of ANMs responded that the E-Aushadhi system is better than the system of maintaining registers, while 19% of ANMs responded that the old system of maintaining stocks and indenting drugs is better than the applications. after all, the challenges experienced by ANMs in the field are a result of the drive to reform the supply chain framework. All ANMs said they had to go to the facility or the Centre to get medicines. They have to carry every medicine on their own, and when asked what mode of transportation they use to take drugs from the facility, they typically choose public transportation, their own vehicle, and walking. They must carry the drugs in a box or a bag and go many km to their local facility or Health and Wellness Centre.

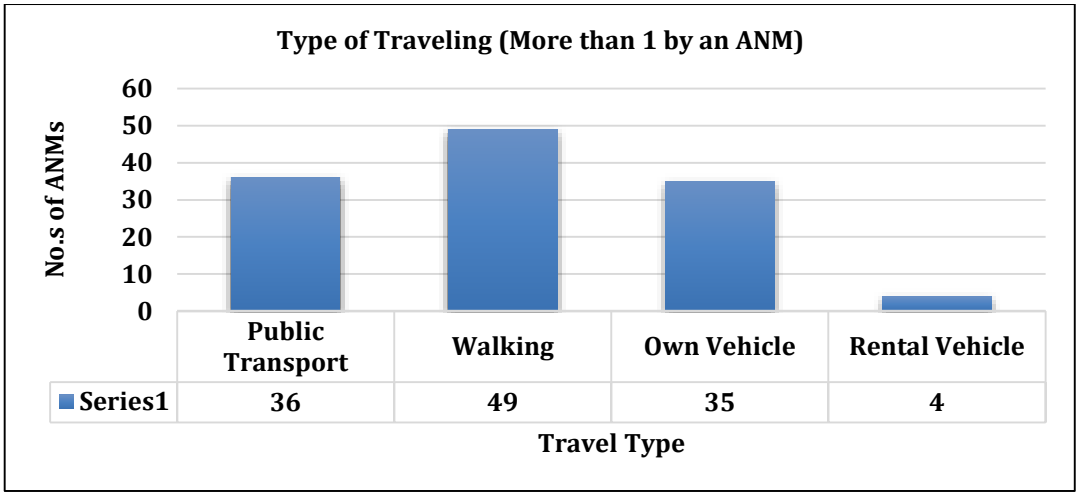

Figure 11. 2D Bar Gaph Representing the Mode of the Transport or Type of the Traveling used by the ANMS to Carry the Indented Medicines

The E-Aushadhi introduces a paperless and online approach for maintaining inventory and supplies in public health care facilities, however ANMs must continue to present a hard copy of the indent to the pharmacist. Otherwise, the pharmacist will refuse to supply medicines to ANMs. When questioned "whether they still have to maintain the stock registers or E-Aushadhi is used to maintain the inventory," 90% of ANMs still use the registers to maintain the stock and record the use of the drugs.

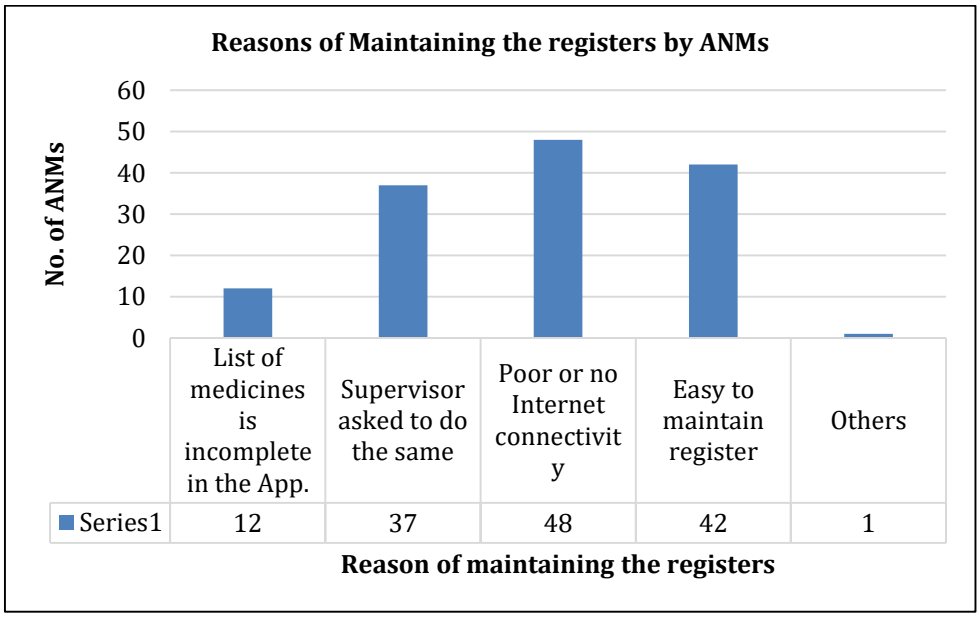

Figure 12. 2d Bar Graph Representing the Reasons of Maintaining the Registers by the ANMS

The majority of ANMs responded that there is a poor internet or connectivity issue in the field, and the supervisor or Block Health Manager Asked to maintain the registers, while other reasons include the ease with which the stock in the registers can be maintained.

3.2 User Perspective & Challenges of the ANMs using FP-LMIS

In the Gaya district of Bihar, FPLMIS is only utilized by a few ANMs while ASHAs, and family planning counsellors keep asking for family planning goods through offline verbal or written communication. The percentage of ANMs who have gotten training for utilizing the FPLMIS in the Gaya district of Bihar was determined to be 37%, with 63% of the others remaining untrained.

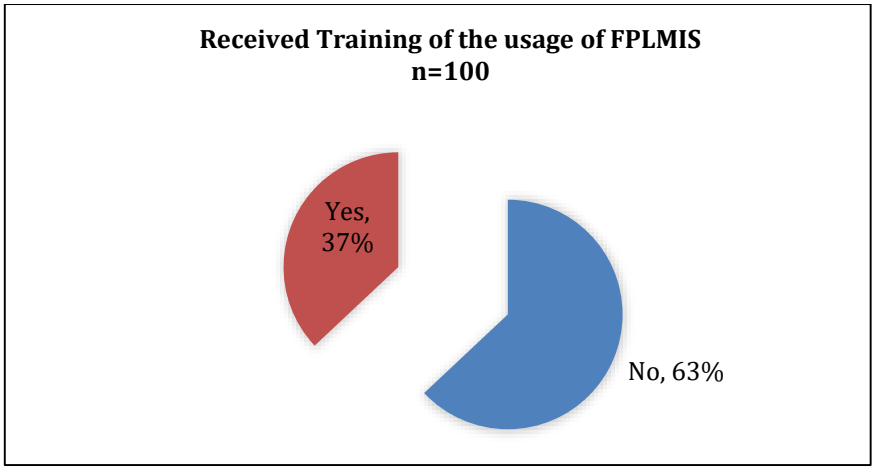

Figure 13. 2d Pie Chart Representing the Percentage of ANMS who Received Training on the Usage of the FPLMIS

When asked if they needed more training to adequately understand the FPLMIS system, approximately 95 percent of ANMs replied yes that they needed more training to efficiently understand the FPLMIS system and its indenting process. The percentage of individuals who use the FPLMIS is quite low, hence the utilization rate is likewise very low. the user satisfaction questions were addressed by the ten ANMs who indented the family planning items. When questioned "whether the FPLMIS application is simple or difficult to use," Almost half of ANMs said the programme is difficult to use, while 30% ANMs finds the application easy to use and user friendly. While 2 ANMs reactions are neutral with the answer.

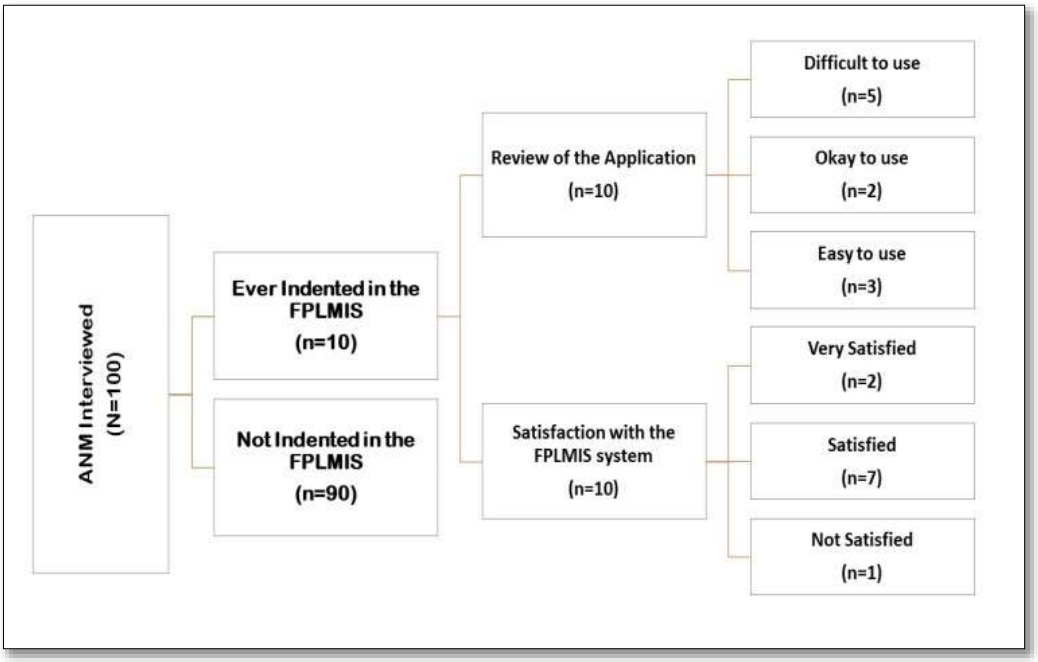

Figure 14. Descriptive Depiction of the Data on the User Satisfaction of the ANMS using FPLMIS Portal

The ANMs who indented the family planning products through FPLMIS were asked how satisfied they were with FPLMIS as a supply chain system. The majority of ANMs are satisfied with the FPLMIS initiative as a supply chain mechanism for family planning goods, with two ANMs being extremely satisfied. However, just one ANM was dissatisfied or responded badly, and the reason was data mismanagement at the FPLMIS interface.

3.3 User Perspective & Challenges of the Pharmacists or Store In Charge using E-Aushadhi & FP-LMIS

The pharmacists from the various block and district level facilities were interviewed qualitatively. The in-depth interviews allowed us to learn more about the problems that the facility and field employees encounter. IDIs also aid in the discovery of many potential solutions that aid in the resolution of problems. The interview demographic data is analyzed based on their qualification for the pharmacist. At the different facilities, there are two B. Pharmacy and six D. Pharmacy qualified pharmacists. even after introducing a modern approach to supply chain management, the pharmacist still faces various issues at the facility level. Inquiring about the difficulties encountered by pharmacists during the supply and inventory management process using E-Aushadhi. The key problems are procuring near-expired pharmaceuticals, a lack of storehouse and human resources, drug call backs due to poor quality, and so on. the main challenge discovered in the analysis was the store's unavailability, and one of the respondents stated that "We don't have enough space to store the medicines in the hospital. As you have seen. Few boxes are out of the room in the lobby. We had requested Pathologist to store our drugs and few drugs are stored in the non-functional toilets and washrooms. This is the worst condition of storage at DH. We wrote twice to the CS but still we are facing the issues."-P4:104. Another significant difficulty is drug batch callback from facilities and late drug delivery from the district or regional ware house. After a few quarters, the BMSICL sent the medications to the facility, and after they received the drugs, the pharmacists distributed them to the various departments. BMSICL instructed them to return the specific drugs in a few cases within 1-2 months since they did not meet the quality criteria, as demonstrated by one of the respondents' answers "We get near expiry medicines, spurious drugs without quality checks. Sometimes, we dispense the medicines in the OPD then, we got to know that the batch was found spurious and did not pass quality check. So, I have to return the drugs to the DDW. This is the common issues we faced in the system"-P4:104. When asked how we might overcome these bottlenecks at the facility level. The pharmacists enthusiastically propose numerous solutions or initiatives to increase supply chain efficiency. The pharmacists also recommend that the drugs should be properly and completely supplied to the facility, and that quality control be conducted prior to delivery to the facility to maintain the quality of the drugs, as demonstrated by one of the participants' responses, "The BMSICL should focus on the quality control test for all the medicines. They should send the medicines once the drug passes the quality control processes."-P4:104. One of the responses also provided a solution for the unavailability of the medicines at the district drug warehouse facility, stating that "The authority also makes sure to give non-Availability license if the drugs are not available in the region through which we can procured drugs for district by using treasury fund."-P7:107. the FPLMIS system is relatively simple at the facility, but pharmacists encounter a hurdle at the ground level system because they face difficulty in recording the consumption at the field, and consumption of family planning commodities is quite low at the field level or at the sessions site. One of the pharmacists said, "This is the major issue from the ground level. As ANMs and ASHAs are not using FPLMIS. They demanded offline, or they received the same from the AVD Green Channel. That's why I won't be able to compile the whole demand from ANMs through an online portal. I have to do double entries to maintain the stock. Moreover, the consumption of the condoms and pills are very low in the whole district."-P1:101.

3.4 Bottlenecks and Identified Gaps of the Supply Chain Management and its Potential Alternatives

Quantitative interviews with the ANMs & In-depth interviews with the pharmacists' aid in identifying the various gaps and issues which act as a bottleneck for the supply chain management. The FPLMIS and E-Aushadhi gaps/Bottlenecks may be classified into three categories: system level gaps, infrastructure gaps, and skill-based gaps. All these gaps are noted in the table below.

Table 1. The Table Represents the Various Gaps/Bottlenecks Present at the Different Facilities

C: Types of Gaps R: Types of the	Infrastructural Gaps	System Level Gaps	Skill & Training Gaps	
			Basic Skills	Comprehensive

Facility				Skills
District Drug Ware House	Unavailability of the store house	Receive Spurious Drugs from the BMSICL Vendors	No Gaps	No Gaps
		Late Supply of the drugs from the BMSICL		
		Late/ No issues of non-Availability licenses		
		Late QC Test of drugs at the Patna		
PHC/SDH/CHC	Unavailability of the store warehouse	Receive late supply from DDW.	The pharmacist lacked fundamental computer knowledge.	Lack of knowledge of the FPLMIS & E-Aushadhi application.
	Improper delivery system.	Improper functioning of the application		
		Lack of Human Resource		Lack of training/skills of the issue and dispense of the medicines via applications
		Doctors do not prescribe medicines according to EDL.		
Field Level	Unavailability of the storage space	The list of the drugs is not customized in the Application	Lack of basic knowledge of the phones and systems among aged ANMs	Lack of training of the E-Aushadhi
	Did not receive the Tablet internet recharge amount			Lack of training of the FPLMIS
	No delivery system			

4. CONCLUSION

The government established the E-Aushadhi system to improve the efficiency of the supply chain mechanism and reduce various hurdles, although the current system still has many issues or bottlenecks. Field level workers continue to face several challenges and limitations, including training for E-Aushadhi, basic and comprehensive skills, a lack of knowledge of applications, and difficulty utilizing smartphones and tablets. This conclusion is additionally supported by one of the research projects done by Pande et al., in the year 2022, who observed these gaps and issues in the state of Maharashtra. However, the introduction of the E-Aushadhi management system increases satisfaction among field level workers. The same conclusion was drawn from a study conducted by Bhardwaj et al. in the year 2022 in the state of Rajasthan, the first state to implement the E-Aushadhi portal. However, in Bihar, The ANMs however encountered challenges such as method of transportation, which required them to walk for 5-10 km with a box full of medicines and go by public transit in the hot weather. After incorporating real-time stock management and consumption entry in the software, there is still a dual system entry, i.e., ANMs must keep stock registers as well as application-based entry for all types of medicine consumption which adds to their workload and leads to confusion. the utilization of the Family Planning Logistics Management Information System by Field Level Workers is quite low, and there is a lack of training and knowledge gaps related with the FPLMIS. Because ASHAs and ANMs do not use the FPLMIS, pharmacists at the facility level have several challenges in managing stock of family planning supplies. However, consumption of family planning-related commodities at the facility and filed level is relatively low. The

use of family planning items is taboo among most people. there are systemic shortcomings, such as the late or non-release of cash for internet recharge, as well as political and administrative will, such as the district health societies and state health society's promises. The primary governing body for medical supply in Bihar is BMSICL; however, there is a significant system level gap in the agency, with vendors delivering substandard and counterfeit drugs to government facilities, leading to batch call backs from the facilities. The supply of the drugs is quite late and sometimes it takes a year or more to get the delivery from the district drug ware house or from the vendors. The BMSICL send the drugs into delivery circulation without quality check process which leads to the consumption of the spurious drugs at the facility level. These are the primary system level deficiencies that the study discovered and inferred. there is an infrastructure deficit at the facility level due to the lack of a drug store house or a room for adequate pharmaceutical storage. There is a dearth of refrigerators at the facility to keep heat sensitive medicines and consumables, thus medicines are kept outside the hospital building, in the hospital lobby or in non-functional toilets or OTs.

There are the stores where the drugs are expose to the rain water and which will also affect the drugs potency and efficacy. There is a severe medicine scarcity in healthcare institutions, and the facilities obtain near-expired drugs from suppliers. Addressing the government's many initiatives in supply chain management and to streamline real-time inventory management. There are still hurdles and bottlenecks identified in the previous sections. The government should focus on capacity building and maintaining system strictness with the assistance of BMSICL and other entities such as the District and State Health Society. The government should improve human resources at each institution since the pharmacy is the most neglected yet most crucial aspect of the healthcare system. The training of staff and field level workers is critical to bridging this gap. Lastly, the strong and positive political and administrative will, is critical to debottlenecking the difficulties and streamlining the whole supply chain system.

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Author Contributions Statement

Name of Author	C	M	So	Va	Fo	I	R	D	O	E	Vi	Su	P	Fu
Rajesh Sharma	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Mansi Rajput	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓
Dr. Anish Sinha	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

Conflict of Interest Statement

The authors declare that there are no conflicts of interest regarding the publication of this paper.

Informed Consent

All participants were informed about the purpose of the study, and their voluntary consent was obtained prior to data collection.

Ethical Approval

Not Applicable.

Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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BIOGRAPHIES OF AUTHORS

	**Rajesh Sharma**, is linked to the Indian Institute of Public Health in Gandhinagar, Gujarat, India. He completed a Master of Public Health, or MPH, there. He is interested in public health and the way healthcare is run. His focus also includes health policy, epidemiology, and community health. In his work, he looks at major health issues faced by different groups. He also studies ways to make healthcare delivery stronger. Another part of his research is using research findings to back public health actions. Email: rajshrm1998@gmail.com
	**Mansi Rajput,** is connected to the Indian Institute of Public Health in Gandhinagar, Gujarat, India. She completed a Master of Public Health, or MPH, there. Her academic focus includes public health and epidemiology. She is also interested in community health, health surveillance, and healthcare research. In her work, she concentrates on population health review and disease prevention. She also looks at public health actions based on evidence. She wants to help communities get better access to healthcare. She also aims to raise health awareness and support better health results.
	**Dr. Anish Sinha**, serves as the Registrar (In-charge) and an Associate Professor at the Indian Institute of Public Health in Gandhinagar, Gujarat, India. He earned an MBBS and an MD in Community Medicine. His work focuses on immunization. He also works on surveillance for vaccine-preventable diseases. Other areas include occupational health and support for health-system strengthening. He has also been involved with the World Health Organization and the United Nations Development Programme. In those roles, he helped with public health programmes aimed at disease prevention and better healthcare.