Original Article

Assessment of e-aushadhi program (drug inventory e-health initiative in Rajasthan) using benefit evaluation framework

Neha Mantri[1], Nitin K. Joshi[2], Pankaj Bhardwaj[3], Balwant Manda[4], Vibha Joshi[5], Kuldeep Singh[6], Rakesh Passi[7]

[1]Master of Public Health Scholar, School of Public Health, All India Institute of Medical Sciences, [2]PhD Community Medicine and Family Medicine, Demonstrator School of Public Health, All India Institute of Medical Sciences, [3]Additional Professor Community Medicine and Family Medicine, Coordinator School of Public Health, All India Institute of Medical Sciences, [4]Chief Medical and Health Officer, [5]Health Economist, Health Technology Assessment- Resource Center, All India Institute of Medical Sciences, [6]Dean Academics, Principal Investigator, Health Technology Assessment- Resource Center, All India Institute of Medical Sciences, [7]District Project Co-Ordinator, District Drug Warehouse, Jodhpur, Rajasthan, India

Abstract

Background: E-aushadhi is a drug supply chain management initiative of the Rajasthan government. This study is conducted to assess this e-health program as evidence is lacking in this context. **Methods:** A mix-method study was conducted. Primary data were recorded from key stakeholders using qualitative interviews. Secondary data were collected from internet-based searches, reports, documents, and available literature. Findings were contextualized into the Benefit-Evaluation framework using six dimensions. **Results:** E-aushadhi provides a systematic approach for sourcing, storing, and re-distribution of essential medicine through its three-tier structure. Its user-friendly dashboard entails accurate entries, customizable reports, and easy tracking. It has reduced workload and improved information management with timely drug supply while allowing monitoring with key performance indicators. **Conclusions:** E-aushadhi has been successful in improving beneficiary access at public health facilities and may act as a backbone architecture for various digital interventions in the National Digital Health Mission that supports the universal health coverage.

Keywords: Drugs, essential, government, information management, internet, medicine

Introduction

E-aushadhi is a drug supply chain management e-health initiative launched in 2011 by the Rajasthan government as a flagship program under the National Health Mission.[1] The first objective is to bring increased transparency, improved information management, improved data usage with accountability within the licensing of Ayurveda, Siddha, Unani, and Homoeopathy drugs (recently only allopathic medicines).[2] To provide cost-free essential medicine under Mukhya Mantri Nishulk Dawa Yojana (MNDY) to every patient visiting public healthcare facilities, e-aushadhi program support in centralized procurement and distribution of generic medicines and surgical items.[3] Access and affordability to essential medicine are key to effective health care services.[4] Mortality figures across the world reflect a large burden of illness, which will be substantially reduced if low-cost

Address for correspondence: Dr. Pankaj Bhardwaj, Coordinator School of Public Health, All India Institute of Medical Sciences, Jodhpur - 3420 05, Rajasthan, India.
E-mail: pankajbhardwajdr@gmail.com

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pharmaceuticals are available and appropriately used.[5]According to the World Health Organization Digital Health Intervention Classification v1.0, it falls in category 3.2 "Supply Chain Management".[6]

"E-aushadhi" introduced in this this aims at improving equity, quality, and efficiency in the health care service delivery.[7] Developed countries such as Canada and the USA have evident studies evaluating the functioning and effectiveness of e-health ventures to guide adaptation decisions. Evidence on the e-health initiative, especially in a developing country, is few, diverse, complex, mixed, and even contradictory. E-health assessment allows us to grasp whether and the way many efforts and investments in the e-health system have led to tangible improvement in performance and better health outcomes. There is a paucity of evidence in India for the implementation and actual benefits of the e-health initiative. A few studies in Rajasthan have discussed the implementation of e-aushadhi and its stated objectives but shreds of evidence of its benefit evaluation are lacking.[8] To justify the deployment of the e-aushadhi program, we elect to get evidence from natural settings to produce a sound foundation for policymakers for managing drug supply efficiently.

Materials and Methods

This study involves the assessment of the e-aushadhi program in the District Drug Warehouse (DDW) using the Benefits Evaluation (BE) framework. BE Framework is based on former work by DeLone and McLean (1992, 2003). It measures the success of information systems (IS) in different healthcare settings and is based on six dimensions namely system quality, information quality, service quality, use, user satisfaction, and net benefits. Ethical considerations for the study were obtained from the Institutional Ethics Committee in September 2020 (Ref: AIIMS/IEC/, IEC NO. AIIMS/IEC/ 2019-20/793).

Primary data were recorded through extensive stakeholder interviews, consultation exercises, and meetings conducted at administrative, managerial, and staff levels. End-user satisfaction was recorded using perception-based interviews. A literature search was done to obtain secondary data. First, a search for publications from indexed journals such as PubMed and Google Scholar was done. Then, an internet-based search from several resources such as newspaper articles, reports, and gray literature was done from 2011 until present on repetitive mode to extensively cover the literature. Additionally, the e-aushadhi dashboard of one of the largest District Jodhpur was accessed to obtain the relevant data for the study purpose. Further, thematic analysis was done to obtain root-level challenges and future recommendations.

Results

Overview of e-Aushadhi

E-aushadhi is a web-based drug inventory management program that provides a systematic approach to sourcing, storing, and re-distribution of essential medicine to citizens visiting public facilities without any charge. It was launched in 2011 in Rajasthan extended as a part of a small pilot project of free drug distribution in Chittorgarh since 2007. Today, 17 states have implemented this program as a supply chain management system in their health care system.[9]

Rajasthan Medical Services Corporation (RMSC, Jaipur) is the nodal implementing agency for the program. An open tender process is held for the centralized purchasing of medicines. Purchase order (PO) based on demand is issued centrally from Jaipur to get supply at DDWs located in every district of Rajasthan.[10,11]

Figure 1 Provides an elaborative overview of workflow in RMSC designated for MNDY scheme implementation through the e-aushadhi program. This program intends to make treatment affordable by clear diagnosis, use of Essential Drug List (EDL), and generic medicines following standard treatment guidelines with education and counseling of patients about the free availability of medicines. E-aushadhi monitors the budget and drug consumption patterns through a passbook system in an optimized way. It works at different levels of public institutions namely medical colleges (MC), satellite hospitals (SH), community health centers (CHC), primary health centers (PHC), and sub-centers (SC).[10,11]

Strong monitoring systems such as double prescription slip, prescription audit, financial audit, and complaint desk allows tracking of medicine consumption at the beneficiary end enhancing the transparency of the program.[10,11]

Dimensions of benefit evaluation framework

Based on the six dimensions of the BE framework, the findings of the study are presented here. Table 1 illustrates the summary of BE framework applied to e-aushadhi drug inventory e-health[12] initiative adopted from the handbook of e-health evaluation (University of Columbia, 2016).

System quality

The system quality of the e-aushadhi program is assessed by functionality, performance, and security in terms of technology.[12]

E-aushadhi functions through its three-tier structure namely database server, application server, and client interface. The database server is used to store and manage databases. It allows users to centrally access the data across the network. Middle tier servers, i.e., application server facilitates seamless integration of business logic in multiple layering architecture including the presentation layer, business layer, and data layer using J2EE technologies such as Java servlets and Web services. The client interface so designed has a user-friendly graphic user interface (GUI) developed using Java Applets and Java Beans. The system has capabilities to access data through intranet or internet through a standard browser application to make it a true web-enabled solution.[13]

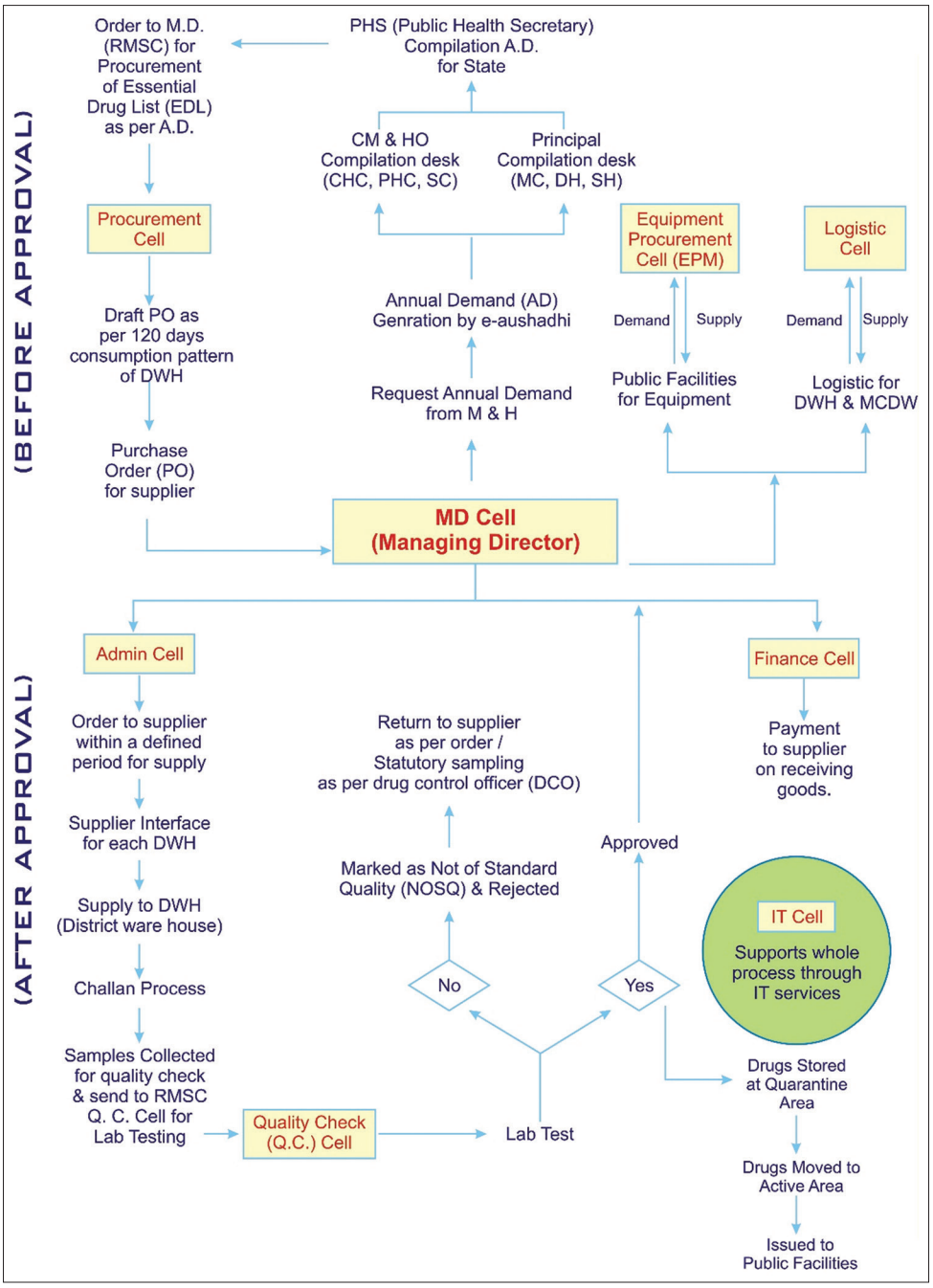

Figure 1: (Original) Workflow of drug supply chain management in RMSC (Rajasthan, India)

Features specific to e-aushadhi are categorized as services and reports. Services include easy inventory, drug locator, drug safety alert pop-up, indent generation, approval desk, physical stock verification, specialized code for each drug, cost estimation calculator, send the sample for quality check, issue and return to sub-stores, challan process, and issue desk online. Reports include stock ledger, drug transfer details, inward challan register, easy tracking of expiry of drugs, and more.

Performance is measured as accessibility, reliability, and response time. Process of demand generation, budget transfer to supply of medicines to patients before e-aushadhi took 6 to 7 months' response time, which has been slashed down to 3 to 4 months only. Data from Jodhpur district revealed that e-aushadhi has improved the accessibility regarding outpatient department (OPD) beneficiaries from 3, 123, 123 to 4, 139, 763 and inpatient department (IPD) beneficiaries from 59, 356 to 82, 577 for the financial year 2015 to 2019. Jodhpur DDW located at the Jhalamand office caters to 10 blocks, namely, Bhopalgarh, Phalodi, Osian, Salawas, Shergarh, Baori, Balesar, Banar, Bilara, and Bap. Thus, it manages 139 stores that include CHC (26), PHC (84), UPHC (22), SH (1), and dispensaries (6) along with different health program supplies such as ASHA training kit, mobile medical vans, and vitamin A.

Table 1: Summary of BENEFIT evaluation framework in the context of the e-aushadhi program

Dimension	Category	Details
1. System	A. Functionality	Three-tier structure, namely, database server, application server, and client interface with features as indent generation, and drug locator.
	B. Performance	Access to remote public health facilities. reduce response time for approval and supply.
	C. Security	Authorized personnel access with SSL digital certificate for security.
2. Information	A. Content B. Availability	Accurate, relevant, complete, and comprehensive information on the portal.
3. Service	A. Responsiveness	Training of software annually by workshops.
4. Use	A. User behavior	Qualification of operating computer software.
	B. Self-reported use	Daily usage and flexible data entry process.
	C. Intention to use	Transparency and easy access increase intention to use.
5. Satisfaction	A. Competency B. Ease of use C. User satisfaction	The paperless systematic process increases work efficiency and makes end-user satisfied. User-friendliness and learnability.
6. Net benefits	A. Care quality B. Access C. Productivity	The timely availability of the right medicine at the right time and place had increased care quality leading to improve health outcomes.

The e-aushadhi program has a secure database system through secure sockets layer (SSL) digital certificate by C-DAC that provides security for online communications.[9] It prevents unethical hacking of systems from cross-site scripting and structured query language (SQL).[13] Authorized access categorized as an administrator, program coordinator, data operator, informatics assistant, and pharmacist. Virtual financial payment (no flow of money) at the drug warehouse level and institute decreases the threat level.

Information quality

It is evaluated in terms of content and availability.[12]

The e-aushadhi program provides rich content of databases regarding medicine procurement, supply, and distribution to the beneficiary. It provides accurate and comprehensive detail of stock availability, the number of beneficiaries, consumption records, etc., at all public facilities. Multilinguistic platform, dynamic reports, key performance indicators, offline/online mode of data entry at any point of time improve its availability.[9,13]

Service quality

It marks responsiveness, namely, the extent and adequacy of implementation of the software.[12]

The implementation of e-aushadhi is systematic and hierarchical that involves the central office (Jaipur) through district drug warehouse (DDW) to public facilities. The training support to staff has been done by the information technology department annually through workshops, and new joiners are given training by existing informatics assistant (IA). Also, a quick exchange of information in groups is facilitated by technological aida such as SMS alerts and WhatsApp. A mobile app for decision-makers gives a holistic picture of the potential impact of its implementation.[9,13]

Use dimension

It involves user behavior and pattern, self-reported use, and intention to use.[12]

The software use requires a qualified computer operator or any IT professional. It has a user-friendly GUI that makes it easy to understand after a little demonstration. Automatic entry of drug details, pop-up alerts, etc., allows the flexible use of the dashboard. Transparency, easy access, and great benefit have increased the usability of these ICT innovations in health departments.[9,13]

User satisfaction dimension

Before e-aushadhi software, drug supply management was a tedious task that includes a lot of paperwork by health staff increasing work burden, unavailability of drugs due to improper line listing, and further delay in approval. Now, a paperless method has increased the work satisfaction level of medical officers prescribing medicine, pharmacists providing medicine to patients, and improvised the work efficiency of the staff at DDW. Increase inter-departmental coordination and sharing of information has a positive impact on the health care of the patient. There is a high level of support to this software by the government to increase the patient quality of care with the right medicine at right time.[10]

Additionally, qualitative interviews conducted with key stakeholders highlighted their perception of improvement in the drug supply chain management through the e-aushadhi program. Most of them are satisfied with this initiative as it has increased their work efficiency.

One of the informatics assistant said:

"*It has provided a substantial help in the efficient control of drug inventory with the dashboard that entails features such as drug locator, record inter-drug*

warehouse transfer, and track expiry drugs, and generates customizable reports, which help in monitoring of the program."

When pharmacist at DDW was interviewed they provided positive perception and one of them mentioned that

"*It is a unique combination of administration and pharmacy paradigm, which help in ascertaining the drug needs of various institutions without any delay benefiting both health care providers and patients.*"

One of the assistant programmers mentioned practical challenge during the interview that

"*It has reduced our paperwork and enhanced work efficiency, but a dedicated fiber network will help in uninterrupted flow increasing user satisfaction."*

Net benefits

It includes care quality and access and productivity.[12]

Care quality is assessed in terms of patient safety, appropriateness, effectiveness, and health outcomes. The procurement of generic medicine is done only from certified vendors and there is no compromise with the efficacy and quality of drugs as compared to branded medicine. Quality check management of drug procurement clears unambiguity in the process. This has increased the effectiveness of treatment offered at public facilities along with better health outcomes.[14]

Figure 2 Data from Jodhpur DDW revealed that there is a gradual increase in cost born by the government for medicines by 50.29% for the financial year 2015–2020 that highlighted reducing out-of-pocket expenditure (OOPE) by the public.

Access and productivity mean the ability of patients and providers to access services such as medicines at drug stores. This system has met the challenges of chronic shortage and acute stockouts of essential medicines.[15] Free and timely access to medicines has motivated people to attend public healthcare facilities, putting pressure on the health system to improve further. An overall improvement in access to health care, financial risk protection, and health system expansion has led our path to universal health coverage.[3]

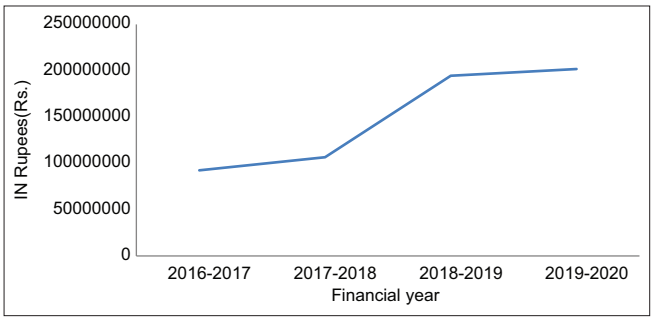

Figure 2: (Original) Illustrates the trend in cost of inward medicines from Jodhpur district drugware house to public healthcare facilities from 2015–2020

One of the administrator revealed a few challenges and suggestion in the interview that

"*E-aushadhi is an application software solution to the drug supply chain in providing primary health care to citizens so that no one is deprived of medicines. We strive to sustain a continuum of care even at the farthest public facilities. Underutilization of infrastructure or human resources and lack of awareness in public are the major constraints. We have improved a lot but there are miles to go."*

Discussion

This study is an attempt to evaluate the drug inventory e-health initiative of the Rajasthan government to smooth the process of drug procurement, storage, and distribution to the public via drug stores at public facilities under the MNDY scheme. In the initial phase, it suffered issues such as a smaller number of medicines coverage, lack of awareness in the public, lack of organizational support, and trust issues of doctors on generic medicines.[5,16] Later, partnerships with the private sector gave a new direction to its implementation. Gradually, it became a cost-effective solution to the administration in organizing data regarding drug distribution of different states and allows comparison.[17,18]

The handbook of e-health evaluation was published in 2006 as the result of a collective effort between the Canada Health Infoway and a group of health informaticians. The BE framework has been proven efficient in evaluating the functioning, implementation, use, and outcomes of any e-health initiative.[12] Previously, also the Benefits Evaluation Framework was applied for evaluating the e-health initiative in developing countries such as India. One of them is the assessment of Asha soft (online payment system) in Rajasthan.[19,20] Thus, we choose to apply the BE framework in a similar health care setting in Rajasthan.

A study conducted by Kotwani *et al.*[18] assessed the availability of essential medicine in the public sector as compared to the private sector in Delhi and marked the importance of free medicine supply to people before the launch of the e-aushadhi program. Similar findings were observed in our study revealing the increased number of beneficiaries at public facilities after implementation of the e-aushadhi program. This initiative has also reduced the OOPE, thus reducing catastrophic expenditure on health. Analysis of 5-year data (2015–2020) revealed an increase of 33% in OPDs and 39% in IPDs beneficiaries at Jodhpur public facilities.

Similarly, a cost analysis by Mukherjee of essential medicine cost to people as compared to free generic medicine has marked the reduced household expenditure to medicine and also highlighted the need to control the price of branded medicines. Data collected from Jodhpur district stated an investment of approximately Rs. 5 crore 24 lakhs for the financial year 2020–2021 (until August). Evaluation of e-aushadhi highlighted the importance of digitalization in the health sector in providing

easy access, availability, timeliness, and smooth inventory management of drug supply at one screen and thus benefitting the maximum people by providing appropriate and suitable medicine promptly.

To achieve its goal of UHC, many flagship programs have been launched since the last decade and one of them is "Medicine for the masses at Jan aushadhi stores" based on the concept of essential medicines' efficacy, safety, suitability, and comparative cost-effectiveness of available treatments.[10,21] Selvaraj *et al.*[3] in their article "Free access to medicine in Rajasthan" has marked this initiative as a stepping stone in achieving UHC goals by increasing population coverage, financial risk protection, and service coverage in Rajasthan.

Transparent and simple graphics allow user satisfaction and improve efficiency at work. Still, some limitations such as a lack of electronic infrastructure or human resources to operate software, lack of training, power cut or improper internet, and unawareness in public regarding free access to medicine act as a barrier in its exemplary implementation.[22]

Though the e-aushadhi program has benefitted its user by reducing workload and increasing efficiency still an extra input of adequate human resource, infrastructure with the dedicated fiber network, bar code standardization and digital signature, continuous training support, and strict guidelines for public health facilities on implementation of the software along with awareness session for the public regarding "free access to medicines" maybe help to utilize the full potential of this e-health initiative.[23]

Further, National Digital Health Mission (NDHM) was launched in 2020 that aims at revolutionizing the efforts of the government in enhancing technology-enabled health service delivery. E-aushadhi has paved its path as the basic architecture for planning and introducing new cross-cutting digital ventures for radically transforming the health ecosystem.[24]

The framework used in the study has a few limitations such as organizational and contextual factors on the adoption and impact of eHealth systems were considered out-of-scope at the time to reduce the complexity of the framework.[12] Further, due to time constraints and feasibility, we obtain additional data from one of the largest districts, Jodhpur. Data from other districts could have provided more comprehensive insights.

Conclusions

This BE evaluation framework has highlighted the revolution brought in drug supply chain management in Rajasthan supporting the noble intent of "ensuring access to quality medicines free of cost." However, better planning and governance are required to plug gaps in its implementation to reach its full impact. Further, to evaluate the perspective of patients about the actual performance of the program, an in-depth analysis is needed.

Abbreviations

BE: benefit evaluation

DDW: district drug warehouse

RMSC: Rajasthan Medical Service Corporation

MNDY: Mukhiya Mantri Nishulk Dawa Yojana

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Nil.

Conflicts of interest

There are no conflicts of interest.

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