Implementation Findings of e-Aushadhi: A Holistic Review

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Abstract: *Healthcare delivery across the globe is undergoing fundamental changes. So ignoring ICT in healthcare delivery is not affordable. The Indian healthcare sector is growing at a brisk pace due to its strengthening coverage, services and increasing expenditure by public as well as private players. Supporting this growth of Healthcare in public sector 'e-Aushadhi' has proved itself a successful system in distribution and management of medicines, surgical equipments and sutures. The new agenda for Public Health in India includes the epidemiological transition, demographical divide, environmental changes and social determinants of health. e-Aushadhi being a radical and liberal environment in its own let the government trace out the actual scenario of health by providing information about relative health statistics of different states, and also the comparisons among them. e-Aushadhi has paved the way to enhance the use of technology as a cost-effective solution to support the administration's step towards new direction.*

Index Terms: *drug distribution, e-Aushadhi, supply chain management, government initiative*

I. Introduction

The term "Health" refers to a State of complete physical, mental, and social wellbeing and not merely the absence of disease or infirmity.'

From ages health has always been an integral part of our lives. Health affects us both mentally and financially. It's not only about individual's health but a complete responsibility towards improving Public Health as a whole. The drive of public health has been potent in India, and has witnessed many barriers in its attempt to affect the lives of the people of this country. Since 1947, major public health problems like malaria, leprosy, tuberculosis, child mortality, high maternal and lately, human immunodeficiency virus (HIV) have been addressed through a concerted action of government.

We have now come a long way witnessing the emergence of a proactive and empowered patient who is more in control of personal health choices. Fledged with information about

Their lifestyle, they expect their relationships with their doctors to be more collaborative and personal, as they work together towards achieving the best outcomes.

Heath care facilities in the country are inadequate to meet the increasing needs of the citizens, particularly in rural areas, where approximately 70% of the people live. One of the priority areas of concern to the common man is accessing health care services.

The work load on government hospitals is increasing by leaps and bounds along with population increase and pro-people policies of Central Government on Healthcare are mostly targeted to reach common people. Mainly down trodden masses are being served by government hospitals in rural and urban areas across the country.

II. Need for e-Aushadhi

The expenditure on health is the second most common cause for rural indebtedness. Health affects us both mentally and financially. It's not only about individual's health but a complete responsibility towards improving Public Health as a whole. Reports of insufficient supply of drugs at several places and shortage of doctors, para-medical staff and pharmacists mainly at the primary health centers (PHC) coerced government to take initiative.

The idea of making healthcare affordable, especially for the poor is the need. Currently drug prices are very high and healthcare is not affordable. About 40 percent of the admitted patients have to either borrow money or sell their assets to undergo treatment. 23% of the sick never go to a doctor or hospital because of their poor financial conditions. This is a grave situation, one that results in loss of thousands of lives every day. This is though real but a preventable tragedy.

It is an established truth that the drug availability in the Indian public health system is always remaining as a problem. One can attribute many reasons like shortage of fund, inefficient indenting procedures, poor inventory management and others for the problem. Recognizing the shortage of medicines in government hospitals, many Indian states have introduced exclusive set ups for the purchase of medicines for the hospitals. They procure medicines through centralized pooled purchases.

Rajasthan Government launched its ambitious scheme of distribution of essential medicines, free of cost to all citizens visiting government hospitals and health care institutions. Managing logistics manually would have been an herculean task and hence with this evolved *"e-Aushadhi, a complete web based supply chain management solution for distribution of drugs, surgical and sutures to various district drug warehouses (DWH), medical colleges, hospitals, community health centers (CHC), primary health centers (PHC) and drug distribution centers (DDC) from where the drugs are issued to the patients, who are the final consumers in the chain."*

e-Aushadhi is a web based application developed on open source platform. It is in a voluminous environment that shelters data of multiple states, their interaction with central application server which again is a layered architecture and finally colligates it into a central database.

The project spread its roots fast and wide with implementing it as a "National Health Mission – Free Drug Service Initiative". It has reached in 15 states until now and more are in the pipeline.

e-Aushadhi contribute to serve around 1-2 lakh patient state/day or even more in some states and managing huge volumes of data with recurrent transactions. The concentrated load is largely managed by 'Central Application Layer'. The Central Application adopts Layered Architecture. The bottom tier is the relational database system; it contains eAushadi Facts, which are Extracted, Transformed and Loaded (ETL) to central database by DPL (Data Processing Layer) and DTL (Data Transfer Layer) of State Database through Web Services. In the middle tier, we have Relational OLAP (ROLAP), which maps the operations on multidimensional data to standard relational operations. This tier is the front-end client layer. This layer holds the query tools, reporting tools and analysis tools.

Login Screens of 9 states

III. Government initiatives

The Indian pharmaceutical industry is continuing its high growth rate at 13% for the last several years. From foreign control to domestic grass-roots growth, the Indian pharmaceutical segment has evolved over the last three decades. According to recent report, healthcare industry has grown to $81.3 billion (Rs 54,086 lakh crore) in 2013 and is now projected to grow to 17 percent by 2020, up from 11 percent in 1990. As that happens, in rural areas, mobile technology and improved data services are expected to play a critical role in improving healthcare delivery.

This rapid growth has yet to translate into a modernization of the Indian distribution system. The main hurdles include the highly fragmented nature of the distribution network, limited advancement in regulatory reforms, and the presence of strong resistance from lobbies of traders involved in the supply chain of pharmaceutical products.

Healthcare normally consists of four components – infrastructure, healthcare manpower, drugs and investigations. The efforts made by government, by taking initiatives, like successful openings of hospitals, acquiring medical devices, having clinical trials, installing advanced medical equipment and providing health insurance, are commendable. Schemes launched by the government like Pradhan Mantri Bhartiya Jan Aushadhi Kendra, Central Government Health Scheme are some of the common known programs which have proved to be immensely beneficial to the masses.

Various schemes for 'Free Distribution of Medicines' are launched by state governments. The common mission of free drug distribution is asking doctors to prescribe generic medicines instead of branded medicines, procuring quality drugs for the government run stores and dissemination of awareness among the people so as to ensure that the poor avail out of this mission.

Provision of free generic drugs through public health facilities is probably the most cost effective way to reduce out of pocket expenditure particularly for poor and vulnerable groups.

The public health system in India comprises a set of state-owned health care facilities funded and controlled by the government. The governmental ministry which controls the central government interests in these institutions is the Ministry of Health & Family Welfare (MoHFW).

MoHFW approved roll out of "National Health Mission- Free Drug Service Initiative" under which e-Aushadhi is implemented across states in India.

IV. Revolution through evolution of e-aushadhi

We are aware that alluding the mistakes or inaccuracy of Health System is as easy as pointing out the flaws in politics? However transformation is a much difficult task.

With an ordinary start in Rajasthan in 2011, one was not aware that this would just be the beginning of a revolution; A nationwide revolution that influenced whole country with its neoteric approach, delivery and performance.

It is about 'e-Aushadhi', software bundled with basic know-how, enormous data, outstanding management routines, proficient logics and manifested solutions. The software kicked-off with the introduction of a framework for e-Aushadhi starting from procurement analysis, gripping its folds into Issue Tracking of medicines, Quality Checking, Payment Modules and some pragmatic reports for end users. Drug distribution in India witnessed a paradigm shift.

A. *Benefits*
Advantages of e-Aushadhi are numerous; few among them are listed below:
1) Provides transparency and smoothness in the process of procurement, supply and distribution of drugs.
2) Have modules useful for day to day activities of drug store like Demand, Purchase Order, Challan, Issue and Transfer of medicines, certifying Quality, returning Not of Standard Quality drugs, Supplier Payment and MIS reports for end users.
3) Allows searching of drugs using number of parameters at all levels for efficient management.
4) Ease of Online Indent and PO Generation directly to Suppliers thereby reducing heavy clerical work.
5) Provision to maintain expiry date / shelf life for an item wherever applicable as it is of great concern.
6) Ability of online tracking of Drug Inventory in all Institutions which is manually unreliable.
7) Better planning, execution and control of demand and supply throughout the state.
8) Best Performance with high number of users has been the USP of the system.
9) Comprehensive User Management and Security.
10) Data driven analytics for effective decision making using Dashboard.

B. *Implementation Methodology*
The project has spread its roots fast and wide. It has been implemented in 17 states until now and more are in the pipeline. e-Aushadhi has become the backbone of the country by proving to be a major stakeholder in making policy decisions.

Implementation Nation wide
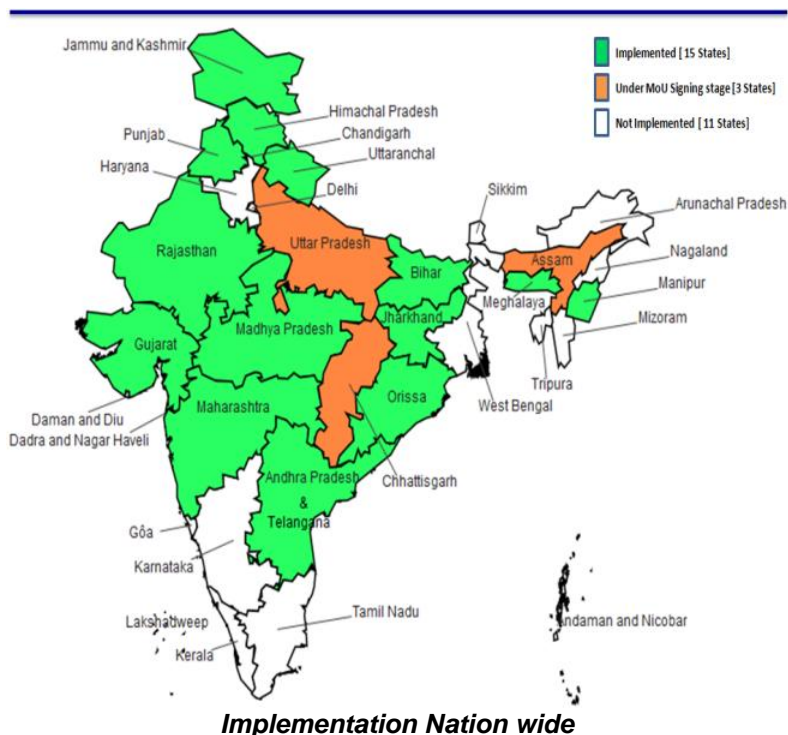
Designing and developing a robust and efficient software system is not sufficient to meet the objectives of the project. Success of the project depends immensely on its implementation methodology. Government supported this cause not only by taxing the software to be in place but through various policy decisions as well like:

1) State government issued various circulation/orders that directed all government doctors to prescribe and use generic medicines instead of branded name drugs.

2) Consumers are made aware by pasting a list of free medicines outside the free drug distribution centers. Similarly comparative price lists are displayed in the same shops.

3) Local electronic and print media are positively capitalized to highlight the price difference between generic and branded drugs.

4) Hoardings are displayed outside the hospitals and important pamphlets are also distributed to patients and their attendants or to the general public as well.

5) Once choice of low cost drugs is available to the consumer, market competition ensures that private medical shops also reduced their prices.

6) Setting up of Low Cost Drug Shops modeled on the lines of fair price shops where generic medicines were given free of cost.

8) Boosted morale of the officials at health headquarters by giving them the bigger picture at the state level via its MIS reports.

We accomplish the project in phase manner and it consists of 4 phases

Stage I – GAD and FSD: In this stage a Gap Analysis Document (GAD) is generated listing the gaps between the system and application being developed, detailing the action plan in the form of a GANTT/PERT that indicates all subtasks, their linkages, and responsibility for each. Finalized System Document (FSD) lists the Hardware Specifications including Connectivity at Head Quarter, on site Project Implementation Unit, Main Store, Sub Store and Drug Distribution Counters.

Stage II – Application Development/Customization: In this stage, the modification/customization and tuning as indicated in the GAD is done. After freezing the customized software, training to end users is imparted.

Stage III – System Installation Stage: In this stage, set up of the system hardware at the data center is done. The setting up of hardware, network, third party software etc. would include up gradation/ up scaling/ enhancement options as per the system requirement.

Stage IV – Operationalization and Operational Support: In this stage, onsite team manages the operations and extends the operational support to the end user. At Data Center application

engineer will ensure the effective management of the software solution. Change Requests from customers is initiated in this stage and application comes under software support and maintenance mode.

e-Aushadhi's success depends a lot on the implementation approach stated above.

C. Services Offered
Modules covered in e-Aushadhi and their brief is explained below:

❖ Demand Management
Demands for drugs can be generated Quarterly/Half yearly/Annually by stores and complied at various levels before freezing at Head Quarter. Indent can be raised based on stock position using Indent Generation. Various processes covered under this are 1. Demand Generation 2. Demand Compilation 3. Demand Freezing 4. Indent Generation

❖ Procurement Management
Multiple Supplier Rate Contract can be defined. PO with multiple drugs at multiple delivery locations with schedule can be made. Various processes covered under this are 1. Rate Contract and Approval 2. Purchase Order Generation and Approval 3. Local Purchase Order Generation 4. Replacement Order Management 5. Supplier Interface

❖ Issue and Receipt Process
Issue to sub stores from warehouse and to patient is available. Material Receipt Report at Challan with Digital Signature is USP of the application. Various processes covered under this are 1. Issue to Sub Store 2. Issue to Patient 3. Issue to Third Party 4. Challan Receive at Warehouse 5. Receive from Third Party

❖ Quality Management
Drugs are sent for QC and remain as inactive until QC is passed. Acceptance Certificate after QC is made. Various processes covered under this are 1. Sample Send from Head Quarter/ Store to QC Cell 2. Sample Receive at QC Cell 3. Sample Send to Lab 4. Sample Receive at Lab 5. Result Entry at Lab 6. Result Acknowledge at Head Quarter

❖ Return Process
Return process includes: 1. Return from Supplier 2. Return from Store 3. Return from Third Party

❖ Transfer Module
Transfer from one store to another for excess and shortage requests can be done. Various processes covered under this are 1. Transfer Excess Request 2. Transfer Shortage Request 3. Transfer Order Generation 4. Transfer within Stores 4. Acknowledge Transfer

❖ Finance Management
Online Payments to Supplier and Lab with bank integration and verifications through digital signature is available. Various processes covered under this are 1. Supplier Payment with Bank Integration and Digital Signature 2. Lab Payment with Bank Integration and Digital Signature 3. Budget Management

❖ Enquiry Module
Drug Inventory for stores is readily available. Dashboards with various statistical analysis at State, District, Store and Department level are available. Various processes covered under this are 1. Stock Position 2. Drug Locator 3. Dashboard 4. Cost Estimation Calculator

❖ User Management
Creation and Management of users of the application is done using roles and seat creation. 1. User Creation 2. Menu Mapping

❖ Miscellaneous Processes
Various operational processes and modifications are made in the application as per requirement like 1. Breakage / Lost Entry 2. Miscellaneous Consumption 3. Donated Item Details 4. Stop Delivery 5. Modifications

D. Features and Utilities
We are indeed aware about the basic features of a Supply Chain Management System that includes the movement and storage of raw materials and finished goods from point of origin to point of consumption by

implementing design, planning, execution, control, and monitoring. One must not aim for ordinary rather distinctive and remarkable. On testimony of this let me discuss some specific and uncommon features of it:

❖ *Multilingual* - eAushadhi communicates in 6 different languages namely English, Hindi, Punjabi, Marathi, Gujarati and Telugu.

❖ *Bar Code & Digital Signature* - Eliminating the possibility of human error, assuring security and improving the legal weight, be it e-signing in Payment Process or providing bar code Interface for areas such as Receiving of drugs, Issue of drugs, Issue for Quality Check etc. e-Aushadhi has it all.

❖ *Alert Management & SMS* - Utility purposed to broadcast information, managing event based and job based alerts and governing the pending tasks as soon as user logs-in into the system. SMS is implemented for critical alerts.

❖ *Mobile App* - Provide the holistic picture of issue under consideration. Mostly used by high level managers and decision makers to keep the bird's-eye-view of the situation.

❖ *Dashboard* - Working in real time management information system, people at higher authorities are often interested in KPI's (Key Performance Indicators), visual presentation of performance parameters and measurement of efficiencies/inefficiencies in present scenario.   e-Aushadhi provides an excelling combination of such features.
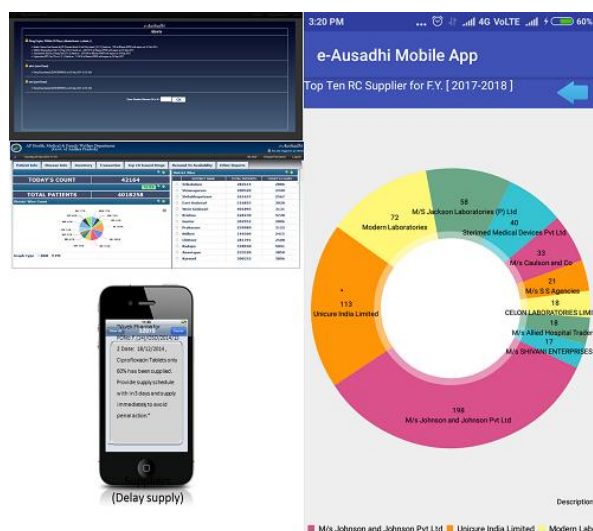
Features of e-Aushadhi (Alerts, Dashboard, SMS, Mobile App)

❖ *Dynamic Report* - Due to intermittent transactions, frequent updates in budget, drug status and store locations; it is strenuous to report the data in fixed format. Dynamic reports with its irresolute formats proved to be beneficial handling dynamic data. Dynamic reports provides an array of related reports and MIS reports for an n-degree review and monitoring of all direct and related parameters For example: Location-wise stock in hand report, Stock Summary Report etc.

❖ *Online/Offline Mode* - Monitoring and tracking of distribution of drugs for around 2000-4000 drug distribution counters through online system, upholding inventory, reviewing expiries and quality standards involve lot of auditing and investigation. Such follow-ups have been provided by e-Aushadhi by providing akin environment for end users. Most of the processes are in dual mode workflow enabled or online and Offline mode so that work can go on without any loss of data.

❖ *Interfacing with other applications* – Many third party applications like Piramal Swasthaya for patient data in Andhra is integrated to make consumption more accurate.

❖ *Security & Standard* – With the advances in IT Sector it is important to maintain the security of application. To prevent unethical hacking or information steal, e-Aushadhi has improved the security by preventing Cross-site scripting, SQL injection and encrypting passwords to achieve 'Safe to Host' certificate by following OWASP standards.

E. Research work

    When one tries to set a benchmark or run over the existing system, they follow the path of research. Commencing with new idea, new techniques, and logics has always been interesting, but at the same time risky. In spite of following the traditional norms, e-Aushadhi believed to form its own touchstone which is nowadays acquiring the recognition across country. To name a few, we would like to share some e-Aushadhi research areas which clinched its existence extensively.

❖ *e-Aushadhi Lite* - Unavailability of internet connections in rural areas raised the need of desktop application. Tracking consumptions of such distribution counters was becoming difficult and hence we developed an installable instance of e-Aushadhi with limited functionality which enabled recording of data through JavaFx. It provisions for data transfer from online to main application and vice versa using XML.

❖ *SMS Based Consumption* - With the advent of various programs of Health Ministry, Family Planning being one of them 'ASHA' Workers are introduced into the system. Tracking consumption of drugs is always a problem area for such programs. We designed an SMS Based consumption system wherein their consumption details are tracked into the system by just doing one SMS.

❖ *Forecasting* - Based on Consumption and Demand operations in a state e-Aushadhi has entrenched a Procurement Calendar on Drift method, which would help states to accurately raise indents and asses the concerns of rural areas relating to acquiring of medicines.

F. Impact

Whenever an application is developed, it can be presumed that decision-makers have made an assessment of potential impacts of application. Impact is basically a link of evidence and decision-making. Certainly there are lots of people who are benefitted by e-Aushadhi.

❖ *Citizens* –The only concern of a person standing in queue for medication is 'Availability of drugs at nearest location'. e-Aushadhi tried its best to serve people by not only delivering drugs, but 'Quality Drugs' through various health centers and counters that have turned up to serve the patients timely and effectively. It has been widely acclaimed as a "bold and courageous" step set to benefit lakhs of poor and destitute people. It has also proved to be a major step towards providing social security to citizens. Drugs of high quality are provided in a hassle-free manner.
* More than 5 crore patients have benefitted in Andhra from e-Aushadhi since June 2015.

❖ *Pharmacist* –This lucid system let the pharmacist know current inventory, restrict him from issuing expired medicines and aid him in maintaining the daily record of patients served.
* Medicines amounting to around Rs.300 crores have been issued in Telangana in CHC, PHC and Hospitals since May 2016.

❖ Medical Corporation / State Government – The prime concern of Head Quarter is the growth and advancement of its state. The triumph of any system is thought about only if it surmounts and justifies what it promised. e-Aushadhi being a popular and favored system shoulder the responsibility of providing the far-ranging accomplishments to the concerned people and assure them that a state on the whole is getting benefitted. Due to efficient payment system implemented as part of the project many recognized suppliers are coming to be a part of states effort. As a result of bulk purchase & transparent tender procedures, the State government has saved on time and money.
*PO Value worth Rs. 600 crores has been raised in Andhra since June 2015.

❖ Central Government –MoHFW required state level comparative data to measure the performance and make critical decisions/adjustments in order to manage, monitor and improve States Drug Distribution in cost effective manner. This is effectively achieved through Central Dashboard. It provides comparative analysis on Rate Contracts, Demand and Procurement Status, Expiry, Stock Details and consumption Pattern.
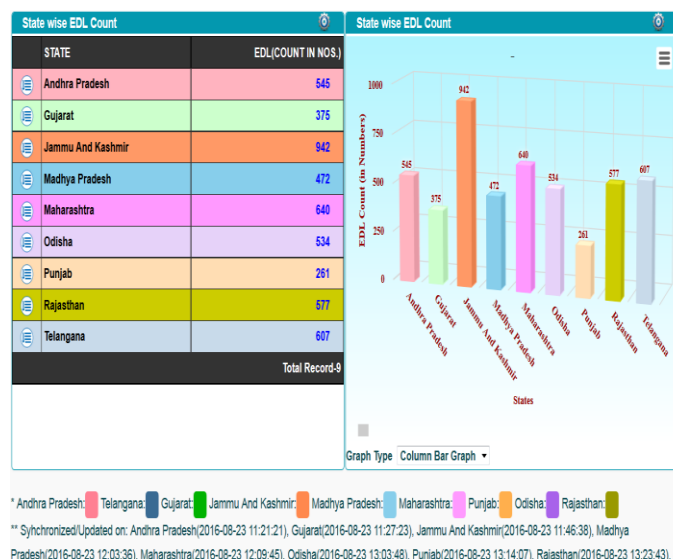
Fig 6: Central Dashboard

V. Success Story

Drug supply chain management has always remained a challenge in the public health systems with respect to its efficiency, transparency, tracking and reporting of various state priority parameters and hence success stories takes time to build.

❖ Rajasthan - e-Aushadhi launched on 2nd October 2011 got implemented in all 33 districts of the state having 3843 DDC counters. Daily serving around 1.9 lakhs of patients. Work started with initial distribution of 200 drugs, subsequently increased to 400 than to 600 and now 1100 drugs, surgical and sutures are being taken care of by eAushadhi.

❖ Maharashtra - More than 18,000 users are using this application regularly updating their information at more than 300 locations. Maharashtra has taken benefit of the system through its deep level of monitoring and access to real time information as a result of which rates of medicines has gone down significantly. It was the first state to have bar code implemented for quality control.

❖ Madhya Pradesh – e-Aushadhi in MP is working in decentralized mode. It has Digital Signatures implemented with Purchase Order, Rate Contract and Payments. Integration with Banks for seamless payments, where no manual intervention is required, is successfully done in MP. Suppliers are hugely benefitted with this system. Payments worth 32 crore is done through system since January 2017.

VI. Conclusion

Implementation of an electronic platform that tracks the movement of drugs from the procurement to the patient through the entire supply chain has become a reality through e-Aushadhi.

Supply chain automation of the drug management system in Maharashtra Public Health Department leads to 20% reduction in cost of medicine, and provides an accurate view of state of drugs warehouse and inventories across the state. Accurate root level reporting and monitoring has been one of the major achievements of e-Aushadhi.

e-Aushadhi has won 7 prestigious Awards across states like PC Quest Best IT Implementations Award of the Year 2014 for e-Aushadhi application, Public Health Department, Maharashtra; State e-Governance award on Year 2013 for Rajasthan Medical Corporation Limited. It has been one of the very few projects that have been able to achieve its objective and provide benefit to all the stakeholders. Scalability and Sustainability of application due to its deployment framework enables state to manage it over the years.

The application has matured with each state experience and has now become a complete product. Its varied features and functionalities give it a cutting edge to its competitors.

VII. Road Ahead

Government has undertaken various initiatives using Information & Communication Technologies (ICT) for improving efficiency & effectiveness of the public healthcare system. Ministry is continuously working on planning and introducing more of ICT initiatives.

Organized retail pharmacies are in a nascent stage in India, but have started making inroads in the distribution system.

e-Aushadhi still has miles to go before it achieves the outstanding. There are 12 more states that need to be implemented under approved nation-wide roll-out plan. The research areas are still at the beginning phases and consumption using mobile technology needs better implementation plans. Forecasting of demand and procurement based on consumption, needs accurate data for creating an effective algorithm which is an apt desire of each state functionary.

The new agenda for Public Health in India includes the epidemiological transition, demographical transition, environmental changes and social determinants of health. e-Aushadhi being a radical and liberal environment in its own let the government trace out the actual scenario of health by providing information about relative health statistics of different states, and also the comparisons among them. e-Aushadhi has paved the way to enhance the use of technology as a cost-effective solution to support the administration's step towards new direction.

e-aushadhi has become the backbone architecture for various other similar ventures and has started its expansion in terms of implementation of the software solution in Family Planning and Tuberculosis.

Acknowledgment

References

[1]. Subitha Lakshminarayanan, Role of government in public health: Current scenario in India and future scope, Journal of Family and Community Medicine, 2011 Jan-Apr, 18(1):26-30.
[2]. Himani Goel, A standalone utility-'e-Aushadhi desktop', Advance Computing Conference (IACC) IEEE International, 2014 :428-431.
[3]. Access to Low Cost Generic Medicines, Rajasthan, Center for Innovations in Public Systems- Health.
[4]. e-Aushadhi Approach Paper, 2017, CDAC