Application of Bar Coding in Inventory Management of Medicines: A Cost Effective Study: A New Age Tool for Healthcare Workers and Patient Safety in Times of Pandemic

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A B S T R ACT

Background : The Institute of Medicine (IOM) 1999 report on the "quality chasm" in healthcare shattered the illusion by stating that visual and transcription errors are at the epitome of unacceptable levels of medical errors that require immediate correction.2 However one of the solution for this problem lies in automation and Barcodes.

Result : When cost effective study done, before and after application of automated process, it was found that for processing of each supply order manually it cost around Rs 600 approx while the use of automation will bring down the cost to Rs 210. Total number of such supply order placed in a particular medical stores will be around 900 over a year. This translates to a savings of more than Rs 351,000 per year.

Conclusion : By utilizing bar code technology, especially portable bar code scanners, the process is quick and very accurate. Automation of medical stores inform of Barcoding of medicines will not only reduce errors (more than 80% reduction in dispensing‐related errors and 50% reduction in bedside administration errors) but also number and severity of ADEs, which will simultaneously improve health record documentation and patient safety.

Keywords: Barcode, automation, cost effective analysis

INTRODUCTION

Healthcare is one organisation where amalgamation of most of skills and knowledge is done inorder to achieve patient safety and to deliver quality patient care. In order to achieve this healthcare professionals learn early in their careers that when humans read or transcribe information there is a small but very real error rate. However, with training, procedural checks, double checks and well-designed processes, it is generally accepted that such errors will be caught and corrected before any real damage is done[1] The Institute of Medicine (IOM) 1999 report on the "quality chasm" in healthcare shattered the illusion by stating that visual and transcription errors are at the epitome of unacceptable levels of medical errors that require immediate correction.[2] However one of the solution for this problem lies in automation and Barcodes. A bar code is a graphic representation of data (alpha, numeric, or both) that is machine-readable (barcode readers). Bar codes are a way of encoding numbers and letters by using a combination of bars and spaces of varying widths. The need of barcoding system in inventory management of medical stores is as shown in **fig 1.**
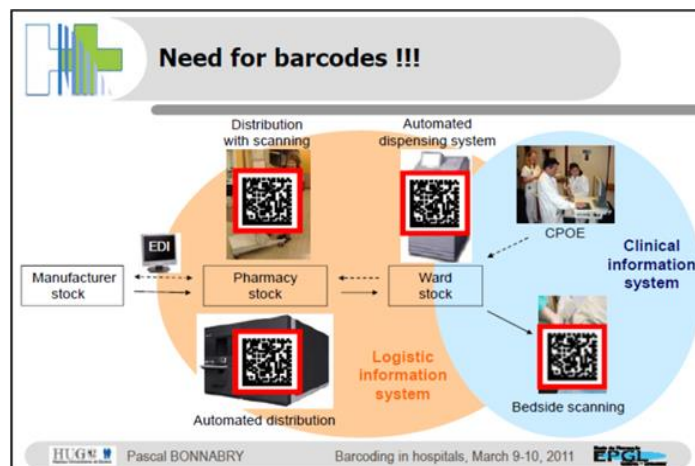

Fig 1 : NEED OF BARCODING AT EACH LEVEL OF MEDICAL STORE INVENTORY MANAGEMENT

1.1The most important advantages of bar coding and automatic data collection are:

▪ **Accuracy**: It increases accuracy by reducing the likelihood of human errors from manual entry.

▪ **Ease of use**: These are easy to use as long as the appropriate hardware and software components are in place to maximize the process of automatic data collection.

▪ **Timely feedback**: It promotes timely feedback of data captured in real time, enabling decisions to be made from current information.

▪ **Improved productivity**: It improve productivity in that many manual activities and tasks become automated, enabling resources to be utilized in other ways to increase efficiencies.

2. AIM

To study the cost effectiveness of implementation of barcoding for inventory management in medical stores of tertiary care hospital in a metropolis.

(a)   To study the present system of inventory management in medical stores

(b)   To study the cost effectiveness of implementing barcoding in terms of accuracy, ease of feedback & patient safety.

2.1 METHODOLOGY

An observational study conducted for one month in which all the medical store inventory management processes along with the challenges and pitfalls faced are studied on ground. A process of implementing barcoding for medicines started with collaboration with GS1 India and a pilot study conducted in order to study the system and to assess the advantages of barcoding vis a vis manual system. A cost effective analysis done in order to understand the process interms of tangible outcomes.

3. Bar Coding System Requirements

To establish a bar code system, four primary components are required a bar code printer, a label for item tracking, scanning equipment for data collection, and an external database for bar code data capture and relay.

3.1 Component 1 - The Bar Code Printer

Bar codes are typically printed by one of four types of printers: dot matrix, ink jet, laser, or thermal.

3.2 Component 2 - The Bar Code Label

Labels are commonly applied on parts, product subassemblies, products, packages and shipping containers, allowing the item to be identified and tracked during internal processing or after it is shipped or sold. An item label can contain any combination of text, graphics, or bar code information, but it is the bar code symbology that facilitates the item tracking process.

3.4 Component 3 – Scanning Equipment for Data Collection

In the data collection phase, scanners are used to instantly and accurately read, capture and decipher the information contained in the bar code label. Scanners read information much faster and more reliably than humans, thus significantly reducing the likelihood of error. Scanners also act as decoders, converting bar code information into a signal that can be understood by a computer system linked to a scanner.

3.5 Component 4 – Data Capture Via an External Database

The fourth and final component of a bar code system is the external database. Bar code applications commonly rely on the availability of external-data computer systems to match an item's unique bar code with pertinent information about the article from a related database. The computer mainframe collects and interprets the data transmitted from the scanner and links the bar code information to a detailed data file on that item. Such data files contain information such as a detailed product description, price, and inventory quantity, enabling transactions and activity to be monitored in real-time. Without this external database, the bar code can have no value [3.]

4. OBSERVATIONS AND DISCUSSION

4.1 Pre Automation Inventory Management Process

During pre automation times, in medical store medicines are received from receipt cell of the hospital manually and then taken on charge in ledger and further indented towards or dispensary (as shown **Fig 2**). This system has many loopholes in form of delay at each and every level along with chances of theft, pilferage and medical errors.
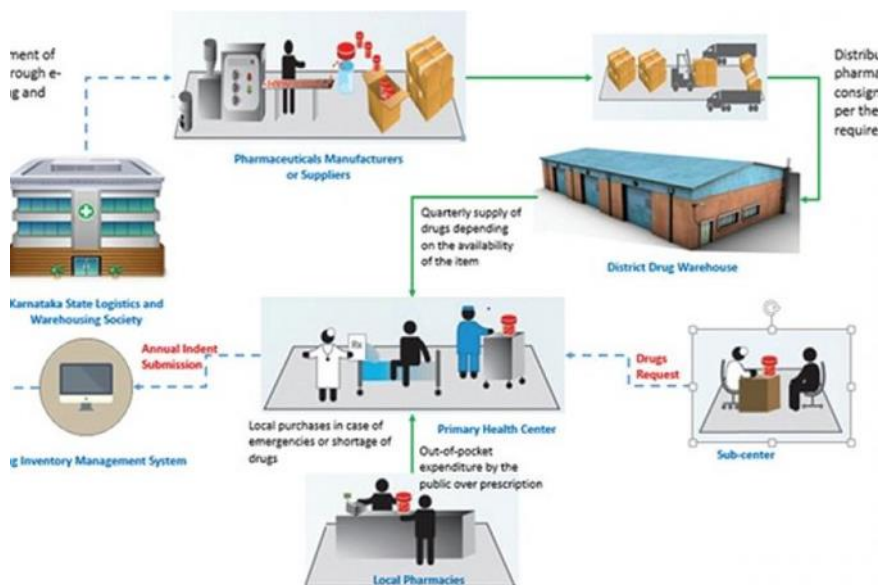

Fig 2 : Inventory Management Module at Primary and Subcentre level

4.2 Post Automation Inventory Management Process

As automation came into being, there are three barcode levels as given in **Table 1**, tertiary barcode is applied on the carton or outer box, secondary on the inner box and primary on the strip level.

Table 1: GS1 standards for each level of barcode

| Packaging Level	Barcode Symbology	Encoded Information
Primary Level Innermost level of packaging, which is in direct contact with the product (e.g., medicine strip, vial, single therapy kit)	GS1 DataMatrix	GTIN Expiry date Batch number Unique serial number
Secondary Level Packaging level containing primary level packages (e.g., mono-cartons)	GS1 DataMatrix GS1-128	GTIN Expiry date Batch number Unique serial number
Tertiary level Outermost level of packaging containing secondary and other intermediate packages that may be used as either a trade item or a logistic unit meant for transport (e.g., cartons, pallets, shipments)	GS1 Data Matrix	GTIN Expiry date Batch number

4.4 Tertiary barcodes are more widely utilized by manufacturers at wholesale units-of-measure such as the case or box level. Hospitals are able to make use of bar code technology during the receiving process with the help of hospital information systems and handheld bar code scanning systems to scan the bar code label on each package. The "received" package's bar code ID is compared with the "ordered" package's ID which is present in form of RCN Barcode Number on the supply order. The software confirms that the received product matches the ordered product and is in the correct unit of measure. The system compares this information with an electronic version of the invoice (e-supply order) commonly called a "three-way match." That is, the invoice matches the receipt that matches the original supply order. This may seem like an obvious result, but it is a very time-consuming and expensive process to perform manually and barcoding saves money and time also prevents pilferage and theft. The process of generating barcodes at vendor level hospital medical stores level is as shown in **fig 3**.
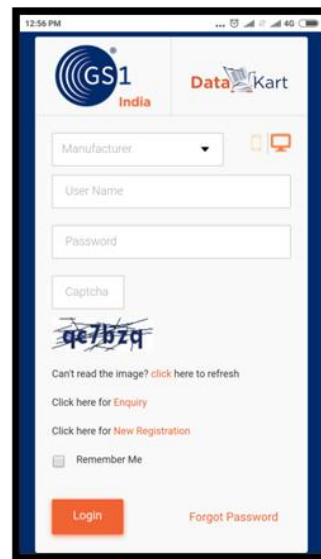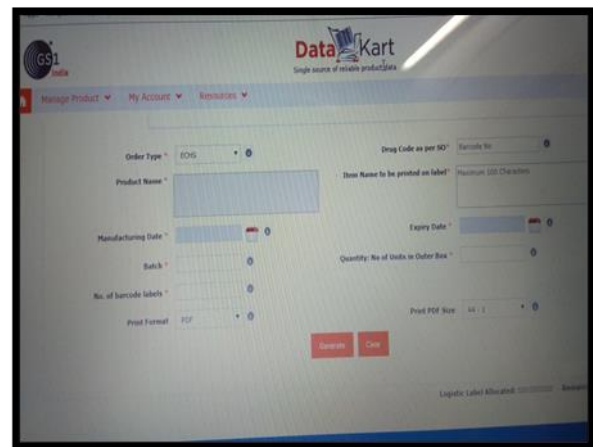
(a) **(b)**
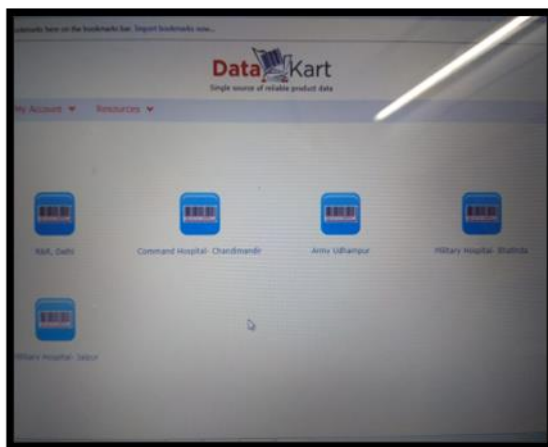
(c) **(d)**

Fig 3 : Barcode generation at Tertiary and Secondary Level

4.5 The observations registered while following the process of barcoding of the medicines for inventory management in the medical stores are as follows:

(a) The focus is on "saving time and money" through the use of bar code technology and automation.

(b) However, "garbage in means garbage out" is very significant to the entire automated supply chain management process.

(c) If accurate product ID, quantity, pricing, and other information is not entered into the system correctly at the first point of contact, then there is very little hope that meaningful savings can be achieved with the system.

(d) The critical component in processing the accurate data is a usable bar code ID to drive the receiving process. However, without a usable bar code ID on the package, the product ID will need to be entered manually, which significantly increase the chances of error.

(e) The efforts in terms of physical and monetary issues which is ensured by an accurate automated receiving process, can be greater than that in a total manual system.

(f) Accuracy is crucial at every stage of the supply chain process, and the most effective method available today is to scan the bar code on the medicine carton/box/strip and also the bar code on the shelf or storage.

(g) Barcode provides a positive verification that the product is being placed in the correct location.

(h) The inventory management system will print the expected quantity-on-hand (QOH) on the supply order or display it on the portable bar code scanner. This enables supply chain employees to be conscious of significant variance in QOH from the amounts that is expected for a given order.

(i) Tally card in medical stores has part number, description, and quantity in logical order. For example, if the products are stored on the shelves in numbered bin locations, the list will be printed in Bid ID order, then healthcare worker moves down the list in order and, in doing so, travels around the stock room in an efficient manner.

(j) The inventory system will generate one list for each ward and dept and the p from that ward will pick all the medicines required for in one go.

(k) The other approach is "tell me what you have" methodology. Utilizing a bar code scanner makes recording the quantity on hand of each item particularly quick, accurate, and efficient. The healthcare worker scans the bar code for the product – either from the package itself or from a bar code ID label affixed to the shelf.

(l) All of this information is stored in the inventory management system and is utilized to compute the replenishment quantity.

(m) With the use of barcoding system, the inventory management system gets updated, accurate and will provide on-hand information.

4.6 Cost Effectiveness

When cost effectiveness study was done on before and after application of automated process, it was found that for processing of each supply order manually, it cost around Rs 600 approx while the use of automation will bring down the cost to Rs 210. Total number of such supply order placed in a particular medical stores will be around 900 over a year. This translates to a savings of more than Rs 351,000 per year.

In terms of manhours, total time expended on execution of complete process from the time a medicine is received by the receipt cell and till the time it is expensed in the dispensary to the patient is 15 hours/ month when it is done manually which changed to 6.5 hours/ month as automation is done. The average gain of manhours is around 8.5 hours/ month which is approx 56% gain.

This will further help in reducing the manpower deployed in medical stores and also help in financial gain due to decrease in investment.

5. Preventive Measures to be Taken at Medical Stores Level

When dealing with barcoding of medicines following precautions need to be taken care of :

▪ **Prioritize the bar coding process**: Hospitals should begin with a review of high-risk and high-usage medications in order to maintain patient safety. Bar coding should starts from medical stores and it is to be ensured that virtually all medications sent to the point of care are bar code labelled.

▪ **Ink levels:** When using a label-generating application in conjunction with either laser-quality or thermal transfer printers for manual labelling of medications, it is important to closely monitor the printer ink level because faint bar codes will pose scanning problems at the point of care.

▪ **Label content**: Labels should contain medication's generic name, strength, volume, container size, expiration date, lot number, and manufacturer, in addition to the RCN bar code number.

6. CONCLUSION

By utilizing bar code technology, especially portable bar code scanners, the process is quick and very accurate. As hospital employees move around the hospital with portable bar code scanners, they identify any medicines that appear to have a low quantity-on-hand for further replenishment. After the bar code ID is scanned, the user enters the actual quantity on hand which will further updates the inventory system with current, accurate, on-hand information of the medicine.[4] The system should then be able to compute a reorder quantity and generate picking instructions to the medical stores or create a replenishment purchase order to the appropriate vendor. Medical stores bar code applications have great potential to increase efficiency and accuracy in healthcare organizations. Almost every back-end function can benefit from bar code implementation with proper planning and the right equipments in form of barcode scanners and printers. Automation of medical stores inform of Barcoding of medicines will not only reduce errors (more than 80% reduction in dispensing‑related errors and 50% reduction in bedside administration errors) but also number and severity of ADEs, which will simultaneously improve health record documentation and patient safety.

6.1 Acknowledgements : Not applicable

6.2 Endnotes : Not Applicable

7 REFERENCES

1.Medication Bar Code System Implementation Planning Section II: Building the Case for Automated Identification of Medications Canadian Pharmaceutical Bar Coding Project August 2013 (Final) Institute for Safe Medication Practices Canada (ISMP Canada)

2.Institute of Medicine (2007) Preventing Medication Errors: Quality Chasm Series

3.Anil K. Sinha, Indian government implements track and trace system for pharmaceuticals GS1 Healthcare Reference Book National Information System.2016-2017

4.Young J, Slebodnik M, Sands L. Bar code technology and medication administration error. J Patient Saf. 2010;6:115–20