

Hospital Supply Chain Management by Implementing RFID

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Abstract- Radio Frequency Identification (RFID) systems have been successfully applied and proved its trustworthiness in various fields including manufacturing, transportation, agriculture, healthcare and supply chain, just to name a few. The use of RFID in healthcare and hospital services has increased significantly over the years due to its credibility and accuracy and plays a crucial role in item level tracking and identification of hospital assets. The objective of this paper is to explain the role, RFID technology can play to ensure patient safety by appropriate handling of medications and to maintain reasonable safety stock of crucial medications and surgical items in hospital pharmacies by tagging the items and integrating RFID into an ERP system. Inventory management in healthcare is crucial such that a certain level of stock of medications and surgical items should be made available at any point of time to meet emergency and non-emergency type situations. The implementation of RFID technology is seen as the solution to ensure patient safety and satisfaction by real time asset management.

Keywords- "Enterprise management", "SCOR model", "RFID", healthcare, hospital.

1. Introduction

Radio Frequency Identification (RFID) technology uses wireless technology of electromagnetic fields to transfer data in order to identify and track tags that are attached to remote objects. RFID is existent for over 50 years; the use of radio waves to identify a friend or foe aircraft during World War II is often viewed by historians as a first application of using RFID [7]. Now, RFID is put to use everywhere including airline luggage tracking, toll collection, library book tracking and considered the next revolution in supply chain management.

The major components of a RFID system are tags, reader and antenna. Tags are the objects that are attached to the items that needed to tracked or identified. The readers are the transmitting and receiving devices that

sends the signals to the tag and also reads its response. The RFID systems vary based on the type of tags and readers used. There are three types of tags that are available active, passive and semi-active tags. Passive tags are cheap and low range that have no on-board battery to power the tag, it relies on the reader's signal to respond. The active tags have on-board battery that powers the tag emitting its known signal and responds to the reader's signal. The active tags are costly but have long reading range and the battery lasts a few years. Active tags have greater storage capacity (2 KB) compared to passive tags. The semi-active tag is the latest technology that combines both the tags. It has an on-board battery but uses the reader's signal to respond. It combines the advantages of both the tags it has longer battery life than the active tag and cheaper than it. It is cheaper and has a better range than the passive tag.

Healthcare industry is one of the fastest growing industry in the U.S and over the past decade, it has added 2.6 million jobs worldwide [9]. The healthcare industry comprises of complex network of physicians, nurses, staffs, hospital management, insurance providers, pharmaceutical suppliers, policy makers etc. The industry faces many unique challenges in providing safe delivery of care for the patients. Specifically, some errors that occur during the patient's processes of care such as medication dispensing errors, use of expired and having incorrect inventory stock information of medication and drugs, needs special attention. A situation like the above can put the safety of the patients in jeopardy and a proper system must be in place to overcome these situations since it involves with precious lives of patients, their safety and satisfaction.

This article deals with the use of RFID technology for item level tracking and identification of hospital's pharmaceutical inventories and integrating with a ERP system as a solution for the aforementioned challenges in a healthcare system. In order to execute this all the materials in the warehouse should be tagged, readers must be installed in strategic locations to monitor the material

flow apart from the handheld readers those can be carried by personnel and all these details should be incorporated to the ERP system so that it can be managed.

2. Background

RFID has already gained its prominence in several industrial applications over the years. One of the early applications of RFID technology was previously tested and was used in tracking animals to a certain extent and it proved to be precursor of using RFID technology to track many players in the hospital environment [2]. Only recently, RFID has got the foothold on the healthcare industry and is already been used in several hospital applications. Some of the prominent applications of RFID in hospitals include Asset Management, Patient Management and Staff Management. With Asset Management, critical hospital assets including the ones used in emergency procedures such as hospitals beds, oxygen tanks, evacuation chairs, fire extinguishers, automated external defibrillators, IV pumps and other assets including blood bags, medicine tracking has already been in place in hospitals. For example, the Texas Health Presbyterian Hospital in Dallas, TX used RFID systems to track over 7000 items and has already realized some benefits including nurses saving 15% of time in searching critical assets and \$30,000 of monthly savings from rental equipment [8]. The Patient Management is centered on improving patient management in within the healthcare supply chain by increased accuracy in patient identification, tracking of drugs and supplies and procedures intended for each patient, dementia outpatient tracking and tracing etc. With Staff Management, the applications of use of RFID lie around better staff utilization, error prevention, improving productivity, improving workflow, staff identification and tracking. For instance, the Royal Wolverhampton hospital in England, has implemented an RFID system for Real Time Location System (RTLS) for multiple purposes including 1. tracking patients inside the hospital to better enable the staff members to guide the patients, 2. track staff members to identify which patient a physician or a nurse had visited, as well as where and for how long, and by doing it, improves the visibility of the services received by the patients and 3. Ability to track hand hygiene of staff members [12].

RFID technology has also been used in pharmaceutical supply chain industries to help in drug flow transparency

As there is a potential situation of items containing materials are hostile to electromagnetic propagation, performance of several Ultra High Frequency (UHF) RFID tags were tested in each test of the pharmaceutical supply chain has been evaluated. On these tested results, a new guideline for high performance tags that were able to handle those critical situations have been designed. This article opens a lot of interest on Item Level Tracing (ILT).

Apart from these, there have been attempts to enhance medication security by using Inpatient Medication Safety (IS) RFID systems [4]. In this system the RFID tags are linked to the inpatients and the medication dosage of those patients. This helps to reduce the medication errors during prescribing, order communication, dispensing, distribution and administration stages of the medication process.

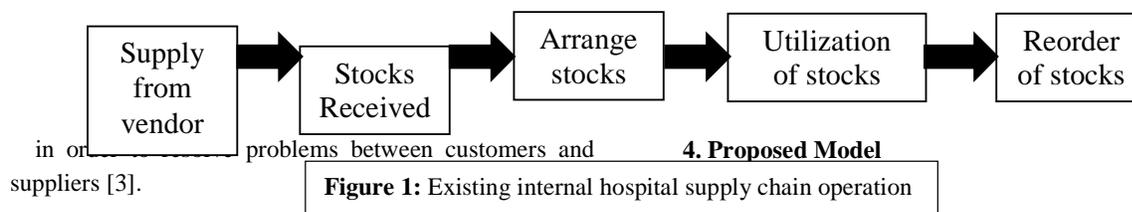
Although RFID technology has enabled good visibility in the supply chain networks with improved product tracking, better inventory management and had helped to reduce the labor cost and human error involved, it also involves some issues and challenges when it is being considered to be implemented in an organization. Some of the issues to be taken in to consideration are the cost of the RFID system, uncertain ROI, change management, training etc. Such a crucial point was discussed and different key issues in implementing the RFID in supply chain network [1] are needed to be recapped.

In this paper, we plan to discuss the implementation steps of RFID technology in the hospital environment. With reference to cost, Return on Investment (ROI), change management was used to understand the benefits of implementing RFID technology in hospital environment.

3. Research Objective

This paper concentrates on hospital supply chain management by implementing RFID. In this paper we propose to integrate RFID to an existing ERP system to improve the hospital supply chain management efficiency. It's obvious that every enterprise is facing challenges in managing their supply chain to balance the supply and demand. In today's world managing the hospital supply chain has become highly critical and has attracted a huge interest for developing a better system to manage its supply chain in an effective way.

Hospitals as an enterprise has completely contrasting environment when compared to other enterprises because



Integration Phase

Figure 2: Integration Vs. Degree of Benefit

it's all about saving human life and well-being so it becomes very critical to manage its supply chain. Here the criticality is not just to ensure the availability of medicines & surgical equipment's but we should maintain the required stock level such that the investment on inventory will remain low. To address this issue most of the hospitals use ERP system to govern its enterprise management, ERP is effective in data collection, storage and retrieval but its efficiency depends on effective usage of its employees, to overcome this issues this paper narrates about the integration of RFID system to the existing ERP system to manage the hospital enterprise. The use of RFID in hospital pharmacy's warehouse will ensure automatic data update of any particular item which will help to access the movement of individual items and will help us for updating the stock level to the ERP system.

In this paper as stated above we have proposed an idea on hospital supply chain management by implementing RFID to ensure cost effective supply chain management. We have proposed 3 phases to integrate RFID to the existing ERP system. Phase 1: Analyzing the existing system & Implementation of RFID in warehouse operation, phase 2:

Monitoring the operation and collecting data, phase 3: Optimizing inventory levels to gain strategic objectives.

In phase I the ongoing process is monitored and the current data are collected this process facilitates better understanding of ongoing system further the collected data is analyzed to figure out the inventory behavior after this RFID is implemented in the current system. Implementation of RFID involves various tedious steps and procedures. With the implementation of RFID the Phase I integration will be done.

In phase 2 data are collected from present operation after implementing RFID. This is very important because the implementation of RFID will provide better access to the material movement which will provide more accurate data of the inventory and material movement across the hospital. Here by using the advantage of visibility a pareto analyzes will be performed to identify the 20% important items which has 80% value in terms of importance and usage. By using the results form pareto analysis we can perform ABC analysis to separate the parts under A, B & C category and handle them accordingly. By progressing to phase 3 the hospital as an enterprise will avail most of

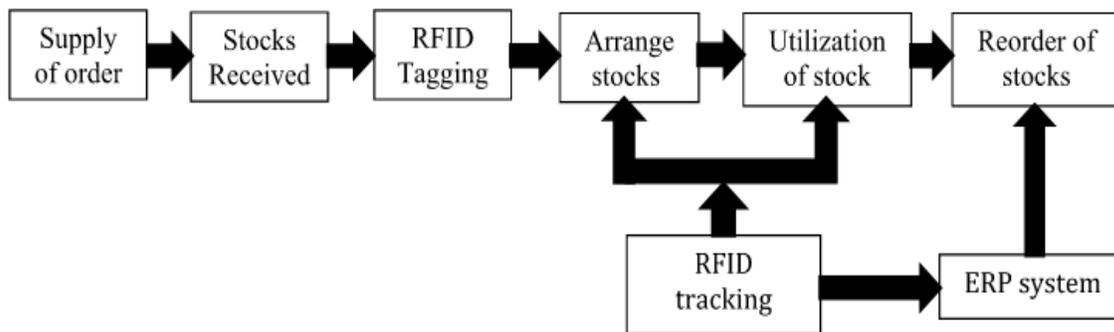


Figure 3. Internal hospital supply chain operation after RFID integration (Phase II)

the benefits thought this integration process in this phase the inventories can be optimized accordingly to balance the cost and need, accurate demand predictions can be made, since RFID provides better visibility of the material movement it facilitates to remodel the warehouse layout if required to facilitate better storage and retrieval of individual items further various vendor's ERP systems can be integrated to the hospital's ERP systems can be integrated to the hospital's ERP system, and the process of continuous improvement can be implemented to improve the supply chain's performance.

5. Model Development (Methodology)

The primary objective of this paper is to integrate RFID to the existing ERP system. To make it work, one should first understand the existing hospital supply chain operation as shown in figure 1. Supply from vendor, stock received, arrange stocks, utilization of stocks & reorder of stocks are the following steps involved in warehouse operation. In this paper we have proposed to integrate RFID to this existing operation as shown in figure.3 which depicts the phase I integration where one can witness RFID tagging is done to the items once after receiving from vendors after that the stock are arranged in the appropriate locations assigned to them after which they are utilized and a reorder level is reached and order of new items are placed. Here the RFID is utilized to track all the activities after tagging which facilitates complete monitoring of items to avail the benefits. Since the RFID is connected to the existing ERP system of the hospital's supply chain management we can

get automatic updates on material movement within the hospital which in turn gives as an idea about the various inventory items utilization using that we can carry out a pareto analyses to figure out the vital 20% items and make

sure that the hospital always have them in their stock. Further using this we can sort the entire items in the inventory in to three category of A, B & C items Table 1 shows the criteria on which items are classified under A, B & C.

Figure 4 below shows the internal hospital supply chain operation after RFID integration (Phase II) here the pareto & A,B & C analysis are linked to ERP system which will facilitates in the stock grouping as mentioned early.

6. Results

In this paper we have proposed a RFID and ERP integration model to improve the hospital enterprise management. This paper mainly focused in inventory management to suggest that RFID implementation will help in better management of inventory and ultimately lead to optimize the inventory to a level where demand and supply can be managed perfectly. This method of integrating RFID to ERP will produce better results in places where the demand is uncertain. In this paper we have considered hospital and pharmacy system, which has an uncertain demand characteristic in its requirement for medication, drugs and surgical equipment.

Items	Priority	Utilization	Time required by the vendor to supply
Item A	High	High	More than a week
Item B	Moderate	High	4-7 days
Item C	Low	Moderate	1-3 days

Table 1. A, B & C grouping criteria table

The most expected result from this integration is the tracking which will help us to optimize the inventory and on the other hand the limitations will be the cost

incurred in the integration of RFID in to Existing ERP system.

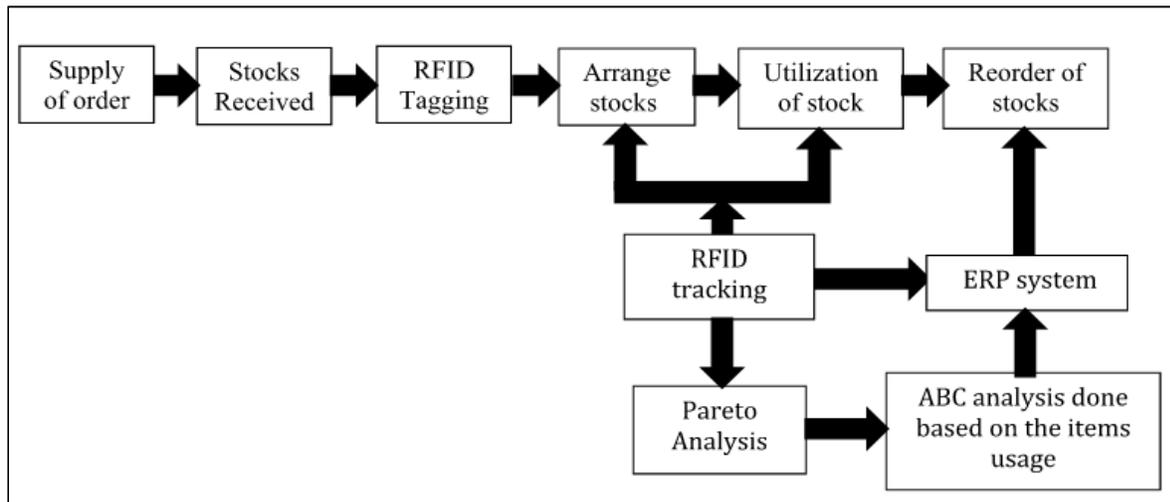


Figure 4: Internal hospital Supply chain operation after RFID integration (Phase II)

7. Conclusion

In this paper we have proposed a basic idea of integrating RFID into hospital's existing ERP system to optimize the hospital supply chain management to overcome the errors due to manual operations of dispensing wrong medication to patients and identifying the items that has passed its expiration date, and also to have sufficient safety stock to meet the emergency and non-emergency needs. By implementing RFID and tracking the items, the hospital management are now in a better position to identify the critical items, place them in strategic positions and would be able to monitor its inventory level. By doing this, a real time inventory level is known all the time and timely reordering of those items can be made without facing an out-of-stock situation.

This paper has some limitations. This is more a theoretical paper in which we have not proved anything with analytical approach this is mainly because we had no real time data on which we can do some mathematical calculations.

We believe that some real time data's from hospitals which are currently implementing RFID technology in their supply chain management system will be more useful to reiterate the model to improve the results.

If we can collect some real time data of a hospital with reference to its inventory we can create a mathematical model to arrive an Return of Investment (NPV) to analytically drive a result on return on investment since implementing RFID requires a lot of capital.

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