



RFID, RTLS and NFC in Healthcare

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Introduction

Every day, healthcare services become more and more complex. This complexity increases the potential of mistakes; one mistake in a procedure may lead to very serious problems and consequences. The correct use of technologies such as RFID, RTLS and NFC can help to better control life-critical processes, people and devices. RFID can be used to establish the dynamic relationships between patients, care providers and the devices connected to the patient. The connection enables the rapid filtering, processing and delivery of critical information directly to the point-of-care through a variety of hand-held devices while concurrently delivering information to clinical data repositories such as the patient medical record. This delivery methodology optimizes and enhances processes, patient care and safety, enabling dynamic and remote monitoring and rapid response to critical issues. When properly implemented, RFID and RTLS can have a tremendous impact on patient safety and quality of care, while at the same time reducing operating expenses.

Such solutions enable hospitals to account for equipment, patients, personnel and processes throughout the enterprise, as well as understand resource status, processes, usage and availability. This real-time information impacts all aspects of the healthcare enterprise including processes, revenue, costs, compliance, and patient safety; thereby allowing hospital staff to assure the right equipment, the right skilled staff resource and the right patient, are in the right place at the right time.

RFID, RTLS and NFC technology

RFID stands for Radio Frequency Identification which is a technology using radio waves to transmit and receive data. Compared with traditional barcode technology, RFID can perform without direct line of sight, operates at higher data communication speed, has in most of the cases no on-board battery, and has a larger data storage capacity than a standard bar code. RFID is considered one of



the most enabling technologies in the healthcare industry today. RFID is helping to improve control and automate processes to meet today's challenges in healthcare.

RTLS means Real-time-location-system and allows the identification, tracking and tracing of patients and objects in real time. RTLS tags are mainly active meaning that the device has its own source of power in the form of a battery and can constantly communicate with the RTLS infrastructure. NFC stands for Near Field Communication and is part of RFID family of solutions. NFC has been developed to enable mobile applications using a consumer smartphone. Today, mobile phone manufacturers offer more than 100 different smartphones supporting NFC technology and this number is increasing every day. In the coming years, every smartphone will be equipped with NFC technology enabling a fast and secured communication between devices and to any NFC tags or cards.

Current applications of RFID adoption in medical organizations

While there is a great focus on adopting RFID in retail (mainly apparel), supply chain and manufacturing, the healthcare industry has also realised the great potential of this technology. In the last few years, there have been many pilots and implementations around the world showing that this technology can assist the healthcare organizations to reduce operating costs, improve patient safety and reduce the number of medical errors.

The major RFID applications in healthcare are:

- Identification and tracking of people (patients, staff and baby)
- Identification and tracking of assets, products and vessels
- Identification and tracking of surgical tools (including sponge)
- Laboratory sample and blood management
- Scrups/garment management
- Supply chain management (receipt, storage, cabinet, supply, output)
- Inventory management (audit, utilization, availability, etc.)

RFID enables automatic linking of people, products with the corresponding processes and also assures government compliance.



Identification and tracking of people (patients, staff and baby)

Attaching an RFID or RTLS tag to the patient at the time of registration enables a proper and automated identification at all time during their stay. Care becomes more patient centric and enables the recording of patient related procedures and medications. The use of RTLS can enhance the patient experience throughout the hospital. Inefficient throughput is one of the major challenges in the hospital environment. It is important for a hospital to serve the patients efficiently as they move through all the stages of care. Studies have shown that hospitals have problems enabling a good workflow for the patient, simply identifying the bottlenecks and operational constraints which exist is not enough, streamlining processes is becoming increasingly critical. Having patients equipped with an RTLS bracelet helps to track and trace the workflow and become more reactive and responsive to overcrowding medical departments, patients turning up in the wrong locations and missing resources. Such real-time information can help to improve room allocation and staff availability resulting in a higher patient satisfaction.

Having caregivers wearing a RTLS badge can result in receiving a graphical overview of the situation. Patient and caregivers can be synchronised in their work activities and timing. Any of these people can be easily located over the system reducing the painful search time. Patient and staff are automatically identified and their presence at the bedside or other critical locations is at any time registered. Important workflow data is created from admissions to the discharge of the patient helping the hospital to analyse and enabling the optimization of their workflow and resource planning. In addition those systems can be connected to the hospital legacy and building security systems.

Before entering a patient room, caregivers must clean their hands using the soap dispenser at the entrance. Now, with the caregiver wearing a RTLS tag the system will trigger an alarm if staff has not been using the hygiene process after having entered the room. This assures that any caregiver complies with the hygiene rules and regulations of the hospital. Should the caregiver still not follow the hygiene process after being alerted, the system will log this non-compliance with the ID and persons details. Such non-compliances can trigger a message to the administration or can be reviewed at any given time over the intranet by a responsible person. Other workflows can be defined as well in the system.



In some cases, caregivers find themselves in a situation requiring assistance. This could be an emerging medical problem, problems with a difficult patient or just the need of another hand. A simple button on the RTLS badge can trigger an alert and message to another staff member or the emergency department.

RTLS is also used to protect new born and infants in the hospital environment and maternity department. Having a baby or infant wearing a RTLS bracelet helps to better control their care and also protects them against baby abductions and unintentional baby mismatching. Each baby is constantly monitored and tracked in real-time from their time of delivery to the time of discharge without influencing the regular and natural movements of mother and baby. A child cannot be removed from the medical department unnoticed and without permission. Some RTLS bracelets also offer a secure, tamper proof function preventing unauthorized removal from the child. Unauthorized removal or tampering will trigger an alert which can notify appropriate personnel and secure doors and exits.

Identification and tracking of assets, products and vessels

In a safe and efficient control environment such as a hospital it is essential to provide high quality patient care and rapid response to emergency situations. Having access to the appropriate equipment and devices is a key and must be available to caregivers when and where they need it. With the use of RTLS and RFID they can stop looking for equipment and focus on patient care. It is the task of the system to make sure that functional and clean equipment is available at the right place at the right time. Thanks to the RTLS/RFID system any staff member can locate the key assets on room, unit and institutional level. The assets and devices can also be identified and categorised as clean and available, in-use, dirty, requiring repair, in maintenance or out of service. This knowledge reduces significantly the search time and enhances resource planning.

When a piece of equipment is malfunctioning or broken, the staff can just push the button on the RTLS tag of the equipment to create a service request to the system. The responsible person is then automatically alerted and advised to replace the device. He also will receive the exact location of the device and corresponding maintenance instructions. Should the device not be repaired or replaced in a specific amount of time, the system will take the necessary actions and alert another appropriate person.



To prevent equipment theft, shrinkage and loss, the appropriate staff can be alerted in real-time when an asset leaves an area. For example, in the case of a medical device inadvertently going down a laundry chute an alert may be instantly sounded.

Thanks to the use of RTLS, assets can also become more intelligent. As an example, a patient's bed can trigger a "dirty bed" notification or a complete room triggers a contamination alert – for example if all assets used in the OR must be properly sanitized before the next procedure.

Improving the management of assets is a killer application in the RFID industry and can significantly reduce lost, safely stock and unnecessary yearly purchases. This applies especially for high value assets such as beds, wheelchairs and infusion pumps. Additionally, laptops and other IT equipment can be better controlled with the use of RFID. The newest RTLS tags can be plugged into a laptop card slot for tracking and managing in designated areas. Such tags come with built-in motion sensors which detect any movement and also have temperature alert.

Identification and tracking of surgical tools (including sponge)

Surgical interventions require a specific set of instruments and calibrated devices. Each tray is assembled and verified before the procedure in order to ensure the correct configuration, the cleaning and decontamination degree. Surgical instruments and sponges equipped with passive RFID tags are automatically detected and inventory is done by just pressing a button. The inventory can be done before and after the intervention, making sure that nothing is left where it does not belong. The identification can be realised with a smart tray or with the use of RFID portals. Any missing instrument and sponges can be easily detected and counted. The system can also store important additional information such as last cleaning and decontamination date/time, last calibration date/time, maintenance, sharpening, amount of autoclave and any other important information.

Laboratory sample and blood management

The use of RFID in biomedical laboratories allows staff to know which sample is in which box and which box is in which freezer. Any removal and movement is stamped with date, time and staff ID. In this way, thousands of samples can be managed more efficiently. No other identification technology would withstand the freezing temperature and frost enabling seamless bulk identification.



Transportation of samples and blood can be also monitored with active RFID tags using a temperature sensor. In this way, any shipment can be constantly monitored for the proper environmental condition and assures no damage during transportation.

Scrubs/garment management

In the last years, hospitals have begun using RFID to minimize their laundry problems. The challenge which many hospitals are facing is in the high amount of work garments such as operating gowns, robes, trousers in its medical and research operations. The management and logistics of such work garments represents a major problem. As the garment moves from staff members to the laundry, than to the storage cabinets and through the wards again back to the staff it can be easily lost or misplaced. Significant time is lost finding the correct garment in the correct size. The laundry process is very harsh and only RFID technology can be used for proper and automated identification. Garments can even be identified in piles on top of each other and on bulky hangers. Inventory can be done in real-time. Staff members can also be easily associated with the respective garment taken. An RFID-enabled garment bin can credit the staff members at return of the garment without any additional paper work.

Supply chain management (receipt, storage, cabinet, supply, output)

In the retail and transportation industry, RFID has proven its efficiency in automating processes within the supply chain such as receiving, storage and shipment. This is accomplished by placing a passive RFID tag directly on the goods or transportation carriers as they come into your facility and automatically gathering the location of goods each time it passes through various RFID enabled check points. In the future, those goods will already be tagged by the suppliers and therefore tagged before receiving them. Knowing exactly where your goods and supplies are at which time allows realization of constant inventory, reduced out-of-stock situations, reduced lost goods, identified goods for replenishment, identified goods out of date and recall of goods.



Inventory management (audit, utilization, availability, etc.)

RFID enabled cabinets, also called smart-cabinets, can help to automatically track consumables such as medication and high value supplies including medical implants. Those cabinets allow real-time inventory management and location tracking by room and cabinet. It also gives important information about expiration date, lot and serial number to allow automatically replenishment or fast recall of the items/devices.

By taking out a specific supply, it allows the staff to automatically assign the usage to the patient's electronic health record and bill. This reduces any failure and can prevent giving wrong or dangerous medication/supplies to a specific patient. The tagging of blister packs and a plastic bottle used by patients fulfils the need to improve anti-counterfeiting but can be used as well to reduce theft, improve stock control and facilitate recalls.

Homecare

RFID can also be very useful in homecare environment. Having different sensors constantly monitoring the condition of the patient without any cables and wires gives a great benefit to the patient. As an example, an RFID and sensor enabled armband can monitor the patient's motion during sleep. Placing an NFC enabled smartphone on the armband allows the transmission of patient data to the responsible care givers and the smartphone could graph the patients sleep length vs. length of time in bed, REM phases or ask a couple of complementary questions. Other sensors could measure small blood samples, oxygen levels, pulse, volatile organic compounds as well as spirometers.

Regional development

The potential of using RTLS/RFID/NFC in the healthcare environment is tremendous. However, the adoption of RTLS and RFID in healthcare organisations is still in the infant stage. The major implementations as of today are around people identification followed by asset management. The Healthcare environment is highly regulated and legislative changes in favour of RFID would have an immediate impact in adopting the technology. For example, legislations in the USA coming from the Food and Drug Administration (FDA), U.S. Health Insurance Portability and Accountability (HIPAA)



and E-Pedigree regulations focusing on solving safety issues have helped a lot in driving the adoption of RFID. In 2011, the company Frost & Sullivan estimated the RFID in Healthcare market around USD 2.4 billion. The forecast for the coming year is showing a compound annual growth rate (CAGR) of 29.9 percent. The fast adopting countries are the USA, UK, Germany, Japan and China. Many other countries, mainly in Europe and South East Asia are very active in realising pilots and are pushing adoption of RFID and RTLS very strongly.

The major barriers blocking adoption are lack of education, limited budgets and long investment cycles. Also not every healthcare facility has the basic IT infrastructure in order to properly implement a technology such as RFID, meaning that major investments need to be included in the RFID project to enable a proper implementation impacting the return of investment of the project significantly. Also the integration of all the different use cases and applications remains a challenge which is in many cases is underestimated.

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