An Overview of RFID Applications in Hospitals

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ABSTRACT: ***After manufacturing and retail marketing, the next logical use for Radio Resonance Identity is healthcare. Although still in its infancy, RFID technology has the potential to substantially cut healthcare costs while also improving patient safety and medical services. However, incorporating RFID into medical practice will be difficult, particularly when necessary expertise is lacking. To investigate this problem, we performed a case study at a Taiwan hospital that showed RFID integration into the medical sector. The Location-based Medicare Service project, which was investigated, was partly funded by the Taiwan government and was targeted at controlling SARS, a deadly illness that hit Taiwan in 2003. The project created an architecture and platform that allows for additional applications, and it was innovative and produced many important outcomes. We explain the project's development strategy, design, and execution in this document. Our results on the collaborative development approach, device management, data management, and value creation are discussed. These results have significant implications for the development of RFID applications in healthcare.***

KEYWORDS: ***Hospital, Healthcare, Medicare, RFID, Service.***

1. INTRODUCTION

The statement by Wal-Mart in June 2003 that it will invest in RFID systems accelerated the technology's development[1]. RFID has the potential to transform a company's capacity to get real-time information on the position and characteristics of tagged individuals or things. RFID is currently utilized in a wide range of applications, including marathon races, airline baggage monitoring, electronic security keys, toll collection, and asset tracking. It's being heralded as the next big thing in supply chain management[2] . RFID research and development is now focused on the industrial and retail sectors in order to enhance supply chain efficiency and get a better understanding of customer behavior. Standard settings, technological constraints, software/middleware development, systems integration, increased prices, benefit appropriation among participants, privacy concerns, and other challenges remain unsolved. Nonetheless, several companies are experimenting with RFID on a limited scale, and numerous companies are collaborating to develop and market the technology. After manufacturing and retail, RFID is expected to find a home in healthcare[3] .

In general, the healthcare sector has been pouring money into information technology (IT) in order to cut costs and enhance patient safety, and RFID is anticipated to play a key role in accomplishing these two objectives. As a result, several hospitals and medical institutions are launching their own small-scale RFID testing initiatives. However, “hospitals have the appearance of a professional bureaucracy in that clinical personnel, particularly medical staffs, exercise significant autonomy”. Many publications have reported failures in implementing IT in hospitals[4] , citing user (primarily physician) opposition as well as technical, clinical/professional, organizational, and implementation problems as causes for failure. These issues may have an impact on the deployment and acceptance of RFID in hospitals, as well as the ambiguity surrounding RFID in terms of technical elements and application practicality. Several research institutions and companies in Taiwan are investigating the use of RFID in supply chain management[5]. Meanwhile, owing to the fast spread of SARS in Taiwan that year, the use of RFID in hospitals has increased since late 2003. Because of the urgent need to control the spread of SARS, several hospitals began exploratory RFID studies as early as October 2003, with government funding.

These initiatives had substantial effects after a year. The Location-based Medicare Service (LBMS) initiative at Taipei Medical University Hospital is the subject of this article (TMUH). We use an exploratory case study method to learn more about the RFID project's strategy, process, and experience[6]. This paper is organized as follows: RFID and its present uses in healthcare are discussed in the next section. Our approach is discussed in Section Three. The case itself, as well as the hospital's and project's history, is described in Section Four. The fifth part explains our results, and the last portion concludes with some concluding comments[7].

1.1 RFID and its current applications in healthcare:

RFID enables data to be stored wirelessly and automatically retrieved. It is a major advance over not just traditional item identification, tracking, and stocking, but also the barcode system. While barcodes can only be read in “line of sight,” RFID does not need a “line of light”. RFID is anticipated to improve supply chain efficiency, increase asset visibility, improve inventory management, automate stock replenishment, and reduce theft and counterfeiting. RFID, on the other hand, is not a single, straightforward technology. Tags, readers,

computer networks, and systems, such as middleware and databases, are all part of it[8]. This technology is not dominated by a single company. There is a whole "ecosystem" of businesses attempting to provide a platform to enable RFID development and applications. For years, the technique has been used by the US Department of Defense. Wal-Mart, Target, and Gillette have all been active in their use and promotion of RFID[7]. Their objectives in implementing RFID included lowering labor costs for scanning goods, decreasing out-of-stock items, reducing theft loss, giving proof-of-delivery, reducing inventory, and enabling retail promotions. The adoption of RFID, a new kind of inter-organizational system (IOS), has been a collaborative effort in supply chain management since linked businesses must embrace the technology at the same time to guarantee efficient operation.

When it comes to implementing RFID in a supply chain, trust, coordination, negotiation, and negotiating power have all shown to be crucial. However, since medical services depend more on personnel and internal procedures than on external providers, the use of RFID in a hospital may not be as widespread. Nonetheless, every company that wishes to use RFID must overcome a number of obstacles, including technical, administrative, and organizational issues. Non-line-of-sight reading, serial number management, and real-time data quantities are three significant difficulties identified by Sarma mostly from a technological standpoint. He believes that developing an RFID infrastructure, as well as middleware and impedance-matching the RFID system to existing systems such as Enterprise Resource Planning (ERP) systems, may be necessary. Rush emphasizes the need of collaboration between IT and business divisions. Place a strong emphasis on project management. In reality, the use of RFID in healthcare has just recently started. Healthcare organizations anticipate RFID to save money and enhance patient safety, and a small but growing number of hospitals are experimenting with the technology, but most, if not all, of the initiatives we see are on a modest scale. Many of them began by keeping track of and maintaining their equipment. In 2004, the Bon Secours hospitals in Richmond, Virginia, tagged its 12,000 pieces of mobile medical equipment, which ranged from wheelchairs to portable heart monitors. Only a few hospitals are experimenting with labeling patients, personnel, and equipment in specific rooms or regions[9].

The emergency room of the Washington Hospital Center in Washington, D.C. installed an RFID system with 20 readers and about 100 tags in October 2004. The goal of this system was to monitor the status and precise location of patients, personnel, and critical equipment. The US Food and Drug Administration (FDA) made a ruling in February 2004 that may enable RFID to be used by virtually the entire pharmaceutical supply chain by the end of 2007. This may help RFID uptake in hospitals. Although tagging things such as medical equipment, medicines, and other items is a possible use for RFID in hospitals, identifying people has greater value and presents more difficulties. Investigated an RFID application at a hospital's emergency department's Level-1 trauma unit and found that data obtained from tagged patients improved medical procedures, decision-making, and resource management. Because expertise from manufacturing and retail is already accessible, equipment tagging may be simpler. Because it includes patients, doctors, medical know-how and procedures, and organizational problems, tagging individuals is more difficult[10].

1.2 The Location-based Medicare Service (LBMS) project:

- The Hospital's History: Hawaii International Conference on System Sciences - Proceedings of the 39th Hawaii International Conference on System Sciences – 2006. The Taipei Medical University Hospital was founded in August 1967 in Taipei, Taiwan, for patient care, clinical education, and medical research. TMUH was designated as a grade-A regional teaching hospital in 2000, and it is currently one of the most prestigious hospitals in the nation. The hospital presently has 416 beds, with plans to expand to 700 beds in the near future. 660 people work in the hospital, comprising doctors, interns, nurses, pharmacists, and medical technicians. TMUH has been a leader in using technology to enhance its medical services. One of the five vice superintendents is solely responsible for information technology. The MIS department's employees are mostly experienced and skilled; their main job is to create sophisticated information extraction applications to assist medical practice and research. The hospital has an HL7 (Health Level 7) and DICOM (Digital Imaging and Communications in Medicine)-compliant integrated healthcare information system. A laboratory information system (LIS), a radiology information system (RIS), and a hospital information system make up this system (HIS). The majority of patient medical records have been digitalized.
- The Project for a Location-based Medicare Service: The World Health Organization (WHO) issued a worldwide warning on atypical pneumonia, also known as severe acute respiratory syndrome, on March 12, 2003. (SARS). SARS is extremely contagious, and it rapidly put hospitals' infection-control systems to the test. In an attempt to prevent the spread of in-hospital infectious diseases, several Taiwanese hospitals shuttered for weeks. As it turns out, the SARS-affected patients' contact history is crucial for

identifying and tracking additional potentially sick people. It takes time and effort to compile a patient's history of interactions with others, but RFID's strong, automated identification and tracking capabilities seemed to have a lot of promise in this regard. Two Singaporean hospitals, Alexandra Hospital and National University Hospital, were the first to use an RFID system in their Accident and Emergency Departments, dubbed the Hospital Movement Tracking System, to monitor visitors, patients, and staff . TMUH began to explore a similar strategy after being inspired by the two Singaporean hospitals' efforts. The Ministry of Economic Affairs (MOEA) and the Taiwan Department of Industrial Technology (DoIT) developed a subsidy plan in August 2003 to promote local companies and institutions to study and develop technology to detect, contain, and treat SARS. Funds have been set aside specifically for hospitals to apply for. TMUH presented a one-year plan to build the Location-based Medicare Service (LBMS) system, an RFID-based system that would be used across the hospital. The proposal was accepted by the government, and the hospital received approximately US$475,000, or about 49% of the project's projected cost. The LBMS system was designed to allow for real-time identification and tracking of tagged people and objects both within and outside the hospital. The goal of the project was to create a functional hospital-wide system, not an experiment or a pilot test. It was essentially an application development and implementation project. It required knowledge and experience from a variety of fields, including medical, RFID technology, information systems development, telecommunications, and systems integration. According to a study of the local and international markets, there was no comparable project elsewhere in the world, and no vendor or consulting company capable of developing such a system on their own. The hospital made the decision to pursue a collaborative approach. TMUH, Lion Information Inc., and an advisory committee were all expected to be engaged. Lion Information, a new company specialized in system development and integration that was based in the University's Innovation Incubation Center, began with this project. Professors from prestigious institutions with expertise in electrical engineering, specialists from a well-known Taiwanese information research center, and other professionals from related areas made up the advisory committee. The three partners each had a distinct role to perform in the project. Based on its medical knowledge, TMUH defined the necessary medical procedures and needs, as well as arranging for installation and system testing. Platform development, RFID technology procurement and purchase, and system integration were all handled by Lion Information. The company purchased technology from research institutions and technology vendors, and collaborated with one university to create new technologies and solutions, particularly in the area of telecoms integration. The advisory committee served as a think tank for the company. The three parties met nearly every week to assess progress and address issues that arose. This approach was effective and contributed significantly to the project's success.

- The hospital also formed a project team led by the superintendent and comprised of representatives from various departments and offices, including the Development Planning Office, Office of Medical Affairs, Emergency Department, Department of Internal Medicine, Department of Surgery, Department of Anesthesiology, and Department of Psychiatry, as seen in most projects. The hospital created a project office and assigned it administrative responsibilities. The goal of the research was to create a system that could identify and monitor (possible) SARS patients. This goal defined the system's direction and key design elements, such as what data would be gathered, who and what would be tagged, how frequently data would be sent and processed, and, most crucially, what value and advantages would be produced. The system was built on the foundation of medical knowledge and practice. RFID was to be seen as a tool to aid medical practice, and the system should reflect this. It was more of a demand-pull initiative than a supply-push one. The hospital determined that the system should include active real-time location tracking, temperature taking capabilities, and monitoring capabilities for tagged patients after analyzing the procedure of managing SARS-infection cases and suspected cases. TMUH selected 916.5 MHz UHF active tags after considering a variety of options. This active tag was considerably more costly than passive tags, but it had a greater reading range and faster reading speed, allowing it to monitor marked people and things more constantly. The hospital determined that SARS patients' badges should include a thermometer. The technology may gather real-time data and minimize the danger of staff illnesses owing to frequent interaction with patients by automating temperature collection and transmission. However, since no such tag existed at the time, an RFID vendor was hired to create one. In the end, the gadgets were supplied almost two weeks late owing to the unanticipated difficulties of creating such a tag. Individuals were compelled to work extra to fulfill the project deadline as a result of the delay. The hospital also purchased additional 916.5 MHz UHF active tags without the temperature design for usage with items such as contaminated trash or clothes when location data alone was sufficient.

2. DISCUSSION

RFID's primary functions are data gathering and transmission. Incomplete or inaccurate readings wreak havoc on future data processing and the production of decision-making data. Device management's goal is to gather and send as many full and clean readings as feasible. RFID is influenced by its physical surroundings and the person(s) or item(s) tagged since it utilizes radio waves and is tagged to a movable person or object. What or who is to be tagged (that is, what are the features and behavior of tag-bearers), what data isto be collected, how often must tags and readers collect and transmit data, and how often does that data need to be considered, what is the physical environment/layout, what are the possibilities Many types of medical equipment in hospitals utilize radio waves.

Patients' lives may be jeopardized if there is any intervention. RFID utilizes radio waves, and although the operational frequency range is limited to the ISM (industrial, scientific, and medical) bands, these frequencies may also cause interference and cause RFID devices to malfunction .As a result, frequency spectrum management is critical. A hospital also has a lot of divisions, rooms, and partitions, as well as a lot of walls and doors. Because building layouts and materials may interfere with radio waves, this may limit the service range of RFID devices. According to one source, the stated range of devices is frequently not achievable in the field, and the actual covering range of readers and field generators should be measured one by one in real settings to decide the portfolio and placements of readers and field generators. Another issue is striking a balance between accuracy standards and investment expenditures. The hospital selected an active RFID system over a passive RFID solution in this project to get more precise readings over moving patients and items. Active RFID solutions are considerably more costly than passive RFID solutions.

3.CONCLUSION

Although RFID in healthcare is still in its early stages, it has the potential to decrease operational costs while also improving medical services and patient safety. Manufacturers and retailers' RFID implementation experience may be reviewed, but it cannot be applied to hospitals without modification. The success of an RFID project is determined by the strategy, implementation method, technological features, organizational environment, and stakeholders, which undoubtedly include doctors and nurses. The commercial value of a new technology is more important than the technology itself. In this case study, we look at how RFID was used to fulfill the requirements and practices of medical services in a single hospital. Synergies like those between TMUH, Lion Information Inc., and the advisory committee may be developed via a collaborative development approach. Medical personnel's presence and participation are also crucial. RFID success in hospitals requires collaboration. This example demonstrates that RFID has the potential to improve operational efficiency, medical service quality, and patient safety. Infrastructure provides benefits and value. The value of RFID is provided via its applications in business, and RFID should be regarded as part of IT infrastructure. RFID as infrastructure offers the hospital a viable alternative. In order to create the infrastructure and applications, device and data management is essential. In addition to the technology itself, the physical surroundings, interference with radio waves, business procedures, domain knowledge, the behavioral side of the individuals to be tagged, the mobility of tagged items and people, cost/benefit considerations, and so on must all be taken into account.

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