Readiness for RFID Technology Implementation: A Feasibility Study in Ophthalmology Hospital

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Abstract

Aim: Since the readiness study is considered a basic step in implementing various technologies, this study was conducted to assess the readiness of Al-Zahra Ophthalmology Hospital for implementing RFID technology.

Method: This descriptive cross-sectional study was conducted in Al-Zahra Ophthalmology Hospital in Zahedan (the eastern province of Iran). Personnel of departments including emergency, management, information technology, and health information management formed the research population. A researcher-constructed questionnaire was used for data collection. The questionnaire consisted of two parts with 37 questions for assessing the hospital readiness and the barriers of using RFID technology. Data were analyzed by SPSS software version 23.

Results: The mean scores of humans, technical and organizational readiness of Al-Zahra Hospital for RFID technology were: 29, 45.14, and 33.5, respectively. In other words, technical readiness was assessed at a good level and human and organizational readiness at a moderate level. The overall readiness of Al-Zahra Hospital for RFID technology has been at a moderate level (mean score of 35.88). The mean score of barriers to using RFID technology was 37.82.

Conclusion: Based on the findings, although there are positive points about RFID technology in terms of technology acceptance, organizational and technical issues, the lack of technical manpower, radio waves equipment, and budget are among the major challenges of RFID technology implementation in Al-Zahra hospital. Therefore, allocating the budget and employing specialized human resources, and creating the necessary technical infrastructure are necessary for implementing RFID technology.

Keywords: Feasibility; Hospital; Health plan; Implementation; Radio frequency identification device

Nowadays, there is a need to automatically identify elements and collect data related to them without the need for human intervention to enter information in many industrial, scientific, service, and social fields. Several technologies have been designed and implemented so far in response to this need, including smart cards, voice recognition technology, and some biometric technologies. In this regard, one of the newest technologies to identify people or goods is the use of Radio Frequency Identification or RFID (1, 2).

The use of RFID technology dates back to at least the 1980s. An RFID system consists of components: RFID tags, antenna, scanner/data readers, and application software for information processing (3-5). RFID technology is similar to a barcode system and can even be considered an evolved generation of barcodes; because barcodes can also be used for this purpose. However, problems with barcode technology lead us to RFID technology (6, 7). In cases such as physical size, lifespan, product code, counterfeiting, dynamic information updates, simultaneous scanning of multiple objects, and prices, RFID is preferable to barcodes (8, 9). With its unique capabilities, this technology has created a huge change in today's world (1, 10, 11).

The main purpose of setting up an RFID system is to receive the desired information from a moving object that data readers read. This information can be about the identity of a particular person, product, object, location, or other information such as price, color, date of manufacture, expiration date, and the like (12, 13). Radio wave identification technology has many applications in health care organizations, including tracking medical equipment and supplies, tracking patients including rapid identification of patients and their locations, control of specific hospital equipment such as radioactive isotopes and other dangerous and harmful materials and equipment, automatic identification of drug packages, use in the laboratory and registration of information of medical samples and blood products, rapid location of goods in the warehouse, registration of entry and exit of all items automatically without human intervention, prevention of theft, the disappearance of infants or patients escaping from the hospital (14-16).

Studies have shown that the use of identification technology with the help of radio waves in hospitals reduces costs, reduces the workload of nurses and other staff, better physician-nurse interaction with patients, and better resource management (12, 17). The use of radio waves can directly affect the cost and productivity of the organization by affecting the working processes in the hospital's operating system, and on the other hand, the use of these waves can indirectly affect the safety and quality of patient care (5, 18). Radio wave recognition technology enables real-time tracking of equipment and people and provides efficient and accurate access to medical data for physicians and other health care professionals (17, 19, 20).

It is clear that to implement any technology, and it is necessary to pay attention to the infrastructures and the conditions for its acceptance. Among the necessary infrastructures for utilizing radio wave identification technology in health care organizations are human, social, cultural, organizational, information and communication technology, and physical and environmental factors (21). Based on the findings of Sepehri's study (2011) entitled "A Model for Implementing Radio Frequency Identification Technology in Hospitals," there is a close relationship between personnel resistance and lack of confidence in RFID technology. According to the study, one of the important issues regarding implementing this system has been the cost-effectiveness of the RFID system (22).

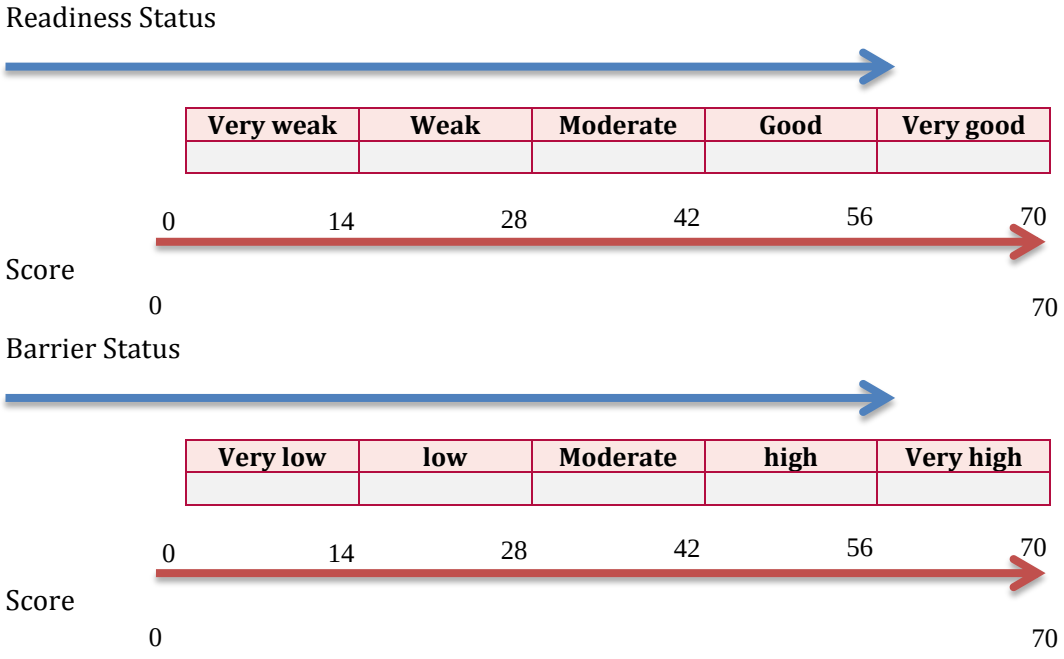
Whereas assessing readiness for technology implementation is an essential step in utilizing various technologies, including RFID technology, and on the other hand, any decision-making and policy-making for the growth and development of hospitals in the use of RFID requires knowledge of the current level of readiness of hospitals; as a result, hospital readiness assessment is essential for the optimal use of RFID technology. Accordingly, the study was conducted to investigate the readiness of Al-Zahra Ophthalmology Hospital in Zahedan for implementing RFID technology.

Method

The present study was a descriptive cross-sectional study conducted in 2020. The study was conducted in Al-Zahra ophthalmology hospital in Zahedan (the eastern province of Iran). Personnel of departments including emergency (22 people), management (1 people), information technology (2 people), and health information management (10 people) formed the research population. Sampling was done by census method, and all the personnel of the mentioned departments formed the research participants.

A researcher-constructed questionnaire was used for data collection. The questionnaire consisted of two parts. The first part included the demographic information of the research population (5 questions), and the second part was the questions related to the objectives of the research, including human readiness (4 questions), technical readiness (14 questions), organizational readiness (8 questions), and barriers to using RFID technology (11 questions). The questions were designed based on three options: yes, no, and to some extent. The scoring options of the questions were as follows: a "Yes" answer scored two-point, a "No" zero point, and a "to some extent" one point. Finally, to judge the hospital's human, technical and organizational readiness according to the participants' opinions, the following scale was used (23-24).

The following scale was also taken to score and judge the status of barriers of using RFID technology (23-24).



The content validity of the questionnaire was reviewed and confirmed by five professors of health information management (3 people) and medical informatics (2 people), and the reliability was determined using Cronbach's alpha coefficient (α = 0.87). Then, in person, a questionnaire was distributed among the participants, and after completion, it was collected. In order to comply with ethical issues in collecting data, the necessary data collection letters were received from the Vice Chancellor for Research of Zabol University of Medical Sciences. The data, for normality, were

analyzed using Kolmogorov – Smirnov test and finally analyzed by SPSS-23.

Results

The study population consisted of 35 people, of whom 45.7% (16 persons) were women, and 54.3% (19 persons) were men. In terms of education level, two people (5.7%) had an associate degree and less, 30 people (85.7%) had a bachelor's degree, three people (8.6%) had a master's degree and a doctorate. In terms of field of study, there were two people (5.7%) in the field of information technology, one in Management (2.9%), two in Medicine (5.7%), 20 in nursing (57.1%), and 10 in Health Information Technology (28.6%). Fifteen people had less than five years of work experience (42.9%), ten people between 5 and 10 years (34.3%), and eight people more than ten years (22.9%). The mean and standard deviation (SD) of age and work experience of the research population were 31.54+ 6.289 and 6.97 + 5.581.

The results of Readiness for RFID technology implementation are shown in **Table 1-3.**

Table 1: The results of participants' perspective on the human readiness for using RFID

Components	Frequency (percentage)			score (Out of 70)
	Yes	No	To some extent	
Sufficient human resources	4(11.4)	13(37.1)	18(51.4)	26
Staff training to implement RFID	8(22.9)	13(37.1)	14(40.0)	30
Training programs to familiarize physicians and staff with RFID	18(51.4)	17(48.6)	0	36
Identifying the staff interested in participating in RFID implementation	6(17.1)	17(48.6)	12(34.3)	24
Mean score	**-**	**-**	**-**	**29**

Table 2: The results of participants' perspective on the technical readiness for using RFID

Components	Frequency (percentage)			score (Out of 70)
	Yes	No	To some extent	
Equipped with internet	17(48.6)	16(45.7)	2(5.7)	36
Equipped with wireless network	13(37.1)	12(34.3)	10(28.6)	36
Equipped with a local area network (LAN)	15(42.9)	18(51.4)	2(5.7)	32
Equipped with barcode reader	27(77.1)	6(17.1)	2(5.7)	56
Equipped with radiofrequency	7(20.0)	12(34.3)	16(45.7)	30
Equipped with personal computer	23(65.7)	12(34.3)	0	46
Has encoding and decoding of the information	15(42.9)	8(22.9)	12(34.3)	42
Equipped with scanner	27(77.1)	0	8(22.9)	62
Equipped with telephone line	35(100)	0	0	70
Equipped with GPS location system (GPRS)	8(22.9)	19(54.3)	8(22.9)	24
Equipped with printer	35(100)	0	0	70
Equipped with sensor	12(34.3)	13(37.1)	10(28.6)	34
Existence of powerful and secure internet networks	13(37.1)	0	22(62.9)	48
Existence of hardware and software equipment	20(57.1)	9(25.7)	6(17.1)	46
Mean score	**-**	**-**	**-**	**45.14**

Table 3: The results of participants' perspective on the organizational readiness for using RFID

Components	Frequency (percentage)			score (Out of 70)
	Yes	No	To some extent	
Budget allocation	2(5.7)	15(42.9)	18(51.4)	22
The support of senior hospital managers from RFID	17(48.6)	0	18(514)	52
Access to the appropriate equipment for RFID implementation	6(17.1)	5(14.3)	24(68.6)	36
Forming a committee to evaluate the feasibility of RFID implementation	14(40.0)	15(42.9)	6(17.1)	34
Assess the current status of the hospital	16(45.7)	7(20.0)	12(34.3)	44
Determining the obstacles for RFID implementation	12(34.3)	19(54.3)	4(11.4)	28
Planning to solve RFID implementation problems	6(17.1)	17(48.6)	12(34.3)	24
Identify the benefits of implementing RFID to reduce resistance	10(28.6)	17(48.6)	8(22.9)	28
Mean score	-	-	-	**33.5**

Considering the mean score of Tables 1 to 3 (29, 45/14, 33/5), the final mean score for the hospital readiness for RFID technology was 35.88. Based on the scale used in the study, the readiness of the hospital to launch and use RFID technology was at a moderate level.

The results of Barriers to implementing RFID technology are presented in **Table 4.**

Table 4: The results of participants' perspective on the barriers of implementing RFID

Components	Frequency (percentage)			score (Out of 70)
	Yes	No	To some extent	
Lack of computer equipment	17(48.6)	16(45.7)	2(5.7)	36
Lack of budget	29(82.9)	0	6(17.1)	64
lack of technical staff	17(48.6)	6(17.1)	12(34.3)	46
Lack of technical infrastructure for implementation	18(51.4)	0	17(48.6)	53
Lack of necessary training	10(28.6)	23(65.7)	2(5.7)	22
Lack of knowledge of employees	4(11.4)	19(54.3)	12(34.3)	20
Lack of efficient planning for implementation	16(45.7)	15(42.9)	4(11.4)	36
Endangering the security and confidentiality of information	12(34.3)	4(11.4)	19(54.3)	43
Employee resistance for implementation	10(28.6)	0	25(71.4)	45
Increase the workload of health care providers	6(17.1)	15(42.9)	14(40.0)	26
The complexity of health care delivery processes	2(5.7)	12(34.3)	21(60.0)	25
Mean score	-	-	-	**37.82**

Discussion

The purpose of this study was to investigate the readiness of Al-Zahra Ophthalmology Hospital in Zahedan for implementing RFID technology. To investigate this issue, various dimensions of hospital readiness, including human, technical, and organizational, were examined from the perspective of the research population, and finally, to confirm these dimensions, barriers to implementing RFID technology were examined.

In terms of human readiness, the highest human readiness in Al-Zahra hospital was related to the training programs to familiarize physicians and other staff with RFID with a 36

and the lowest readiness related to identifying staff interested in participating in RFID implementation with a score of 24. Considering the findings related to human readiness (Table 1) and the mean score of this dimension, it can be said that the status of human readiness of the hospital was at a moderate (mean score of 29). Based on the findings of the present study, investigating the interest and willingness of the hospital staff to participate in the implementation of RFID and the lack of manpower has been one of the important challenges in the human readiness of the hospital. These findings are consistent with the findings of other studies. For example, based on the findings of Sepehri's study (2011), there is a close relationship between personnel resistance and uncertainty about RFID technology (22). Based on these studies and the findings of the present study on human readiness for RFID technology, it can be generally said that although human resources may be inclined to receive training on RFID technology, serious attention must be paid to personnel resistance. While focusing on the efficiency of RFID technology is also very helpful and can, to some extent, affect the issue of employee resistance and reduce the level of resistance.

Regarding the technical readiness of the hospital, the findings of the study indicate that most of the equipment which is available in this hospital was related to the presence of printers, and the least available equipment was related to radiofrequency (score 30). According to the findings (Table 2), the level of technical readiness of the hospital is good. Even though the study's findings show that the technical readiness is good (mean score 45.14), the lack of equipment relevant to radiofrequency is the most important challenge in terms of hospital technical readiness. Based on this finding, without supplying these facilities, the technical utilization of this technology will not be possible. As Ngai et al. (2009), in a study entitled "Design of an RFID-based Healthcare Management System Using an Information System Design Theory," mentioned that the poor transmission of RFID waves in parts of the hospital is due to technical issues or the hospital building and they stated it as one the disadvantages of implementing this technology (25). In general, in the technical field, it can be said that the technical infrastructure required to implement RFID technology in the hospital under study is not enough, and the lack of technical staff and radiofrequency equipment have been one of the major challenges in implementing this technology. Therefore, it is necessary to supply the necessary equipment related to radiofrequency and to employ specialized human resources in the technical dimension.

The highest organizational readiness in Al-Zahra Ophthalmology Hospital was related to the support of senior hospital managers from RFID (score 52), and the lowest was related to budget allocation (score 22). According to Table 3 and the mean score of the organizational readiness dimension, the organizational readiness of the hospital was moderate from the participants' perspective. Based on the findings of organizational readiness, the hospital's senior management supports the use of new technologies to improve the health care process but faces a significant challenge in funding. Although the positive outlook and support of the organization's senior management are very useful, it is clear that it will not be possible to launch this technology without funding. Based on the Findings of Ebrahimi's (2015) study, paying attention to the managerial dimensions of RFID technology implementation is very vital. The findings of Ebrahimi's study also emphasize the allocation of funding, improvement of technical and communication infrastructure, and planning for the implementation of this technology (26).

Examining obstacles and problems in implementing RFID technology also showed that the most obstacles and problems were lack of

budget (score 64). According to the findings, the status of barriers for using RFID technology has been at a moderate level. Regarding the barriers to the use of RFID technology, the findings of the present study are consistent with the findings of some studies, including Bastani (2016) and Sepehri's study (2011). Bastani et al. (2016) examined "challenges and requirements of RFID technology establishment in the healthcare industry." In this study, some of the vital uses of RFID technology in the hospital system, such as patient tracking, drug equipment identification and verification, improving the quality and safety of patients, are mentioned. Based on the study's findings, this technology faces various challenges to improve quality and increase patient safety. Among the most important challenges for RFID technology include project funding, technical constraints, privacy concerns, lack of support from managers and senior decision-makers (27). Sepehri (2011), in his study entitled "A Model for the Implementation of RFID Technology in Hospitals," states that based on the effective indicators in the implementation of this technology in hospitals, the main issue regarding the implementation of RFID technology is the cost and justification of the benefits and advantages of this technology (22). Accordingly, paying attention to the mentioned challenges when launching and planning for this type of technology is significant for all officials of medical centers.

Based on the summary of human, technical and organizational aspects studied in this study, it can be said that the readiness of Al-Zahra Hospital in Zahedan for the implementation of RFID technology has been moderate (the final average of the studied dimensions was 35.88). On the other hand, the study of obstacles and problems in the implementation of RFID technology also showed that the situation of obstacles to the use of RFID technology is at an average level. The results of the study by Ebrahimi (2015) also showed that hospitals affiliated with Shiraz University of Medical Sciences are at a moderate level of readiness to launch RFID technology (26). Therefore, considering the plans and benefits of using RFID technology, hospital officials are expected to allocate budget, improve the technical and communication infrastructure, and plan to implement this technology.

Conclusion

Based on the results, it seems that Al-Zahra Ophthalmology hospital is not ready to implement RFID technology in general. Although there are positive points about RFID technology in terms of technology acceptance and some organizational and technical issues; the lack of technical manpower, the lack of equipment related to radio waves, and the lack of budget are among the major challenges that cause the hospital's readiness to face major problems for using this technology; therefore, the complete readiness can be achieved by allocating budget and employing specialized manpower, as well as supplying technical infrastructure.

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