Original Article

Staff awareness, attitudes, and skills toward radio frequency identification adoption in medical laboratories

Peivand Bastani[1] **Ali Reza Yusefi**[2]* Somayeh Alipoori[3] Aida Pajoohesh[4] Sara Jamalabadi[5]

1. Assistant Professor, Health Human Resources Research Center, School of Management and Medical Informatics, Shiraz University of Medical Sciences, Shiraz, Iran
2. PhD candidate of health services management, Student Research Committee, Aliasghar Hospital, Shiraz University of Medical Sciences, Shiraz, Iran
3. MSc in HealthCare Management, School of Management and Medical Informatics, Shiraz University of Medical Sciences, Shiraz, Iran
4. BSc student in HealthCare Management, School of Management and Medical Informatics, Shiraz University of Medical Sciences, Shiraz, Iran
5. PhD candidate in Health Economics, Hamburg Universitat, Hamburg Center for Health Economics, Hamburg, Germany

*Correspondence to: Ali Reza Yusefi
alirezayusefi67@gmail.com

Abstract

Background and purpose: Radio Frequency Identification (RFID) technology is a beneficial tool in providing diagnostic and treatment services in the healthcare domain. This study aims to investigate awareness, attitudes, and skills of medical private and public laboratory the staff in implementing RFID.

Materials and Methods: The present study was a cross-sectional study conducted based on the descriptive-applied approach in private and public medical laboratories in Shiraz in 2017. The population size of this study included all laboratories' staff that involved technicians, technologists, and technical supervisors. 147 staffs were then assigned through census. Data was collected using a researcher-made checklist, and its validity and reliability were assessed and approved. The collected data was then analysed in a significance level of 0.05 using descriptive statistics and t-test, ANOVA ,and Pearson correlation test in $SPSS_{23}$.

Results: Findings showed that the mean awareness, attitude and skill scores of participants were 3.13 ± 0.91, 4.09 ± 0.38 and 2.39 ± 0.65, respectively. In this regard, the staff awareness and attitude scores labelled good, and their skill score labelled medium. Also, almost all participants had a positive attitude toward executing RFID, and there was documented a significant direct association between the staff knowledge, attitudes, and skills dimensions.

Conclusion: Considering the inchoate RFID technology and its limited usage, the staff RFID skills needed improvement. Therefore, the results suggested that the necessary training followed by implementing RFID technology should have received a high-level priority on policymakers' agenda.

Keywords: Awareness; Attitude; Skill; RFID Technology; Medical Laboratory

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1. Introduction

Radio frequency identification is one of the recent technologies which has been introduced in the healthcare system. This technology assumes to improve efficiency and effectiveness of healthcare performance (1). This wireless technology is capable of automatic identification which uses the radio frequency for identifying objects and gets information without human interference (2-4). Radio frequency identification (RFID) has also been applied in different organisations for decades, and it has been used in healthcare centres like hospitals since 2004. Following that, some American hospitals initiated to plant RFID in patients' bodies to better manage their care (5,6). RFID has a wide range of applications in tracking and identifying things and individuals, which provides accessibility to precise medical information for healthcare professionals. It also reflects on solving healthcare problems, and facilitating more efficient service delivery (5,6). Literature indicated that using the RFID technology in healthcare can be of help in lower cost, improve efficiency, quality of services, and patient satisfaction (7,8). Peris-Lopez et al. showed that RFID leads to raising the efficiency of hospital staff in pharmaceutical distribution and facilitates the work conditions for nurses, physicians, and other pharmacy staff (9). Fisher and Monahan's indicated that implementing RFID facilitated work circulation in hospitals and lowered the nurse workload. The apaplication of this technology also caused better interaction between physician and patients from their physician's perspective (5). Van der Togt et al. found a positive influence of RFID on automatic identification, consistency,

and supervision of blood products condition (10). Reducing medical error was also among the applications of RFID (11,12). Based on IOM estimation, between 44,000 and 98,000 people die in the USA hospitals each year because of medical errors (13) that could have been prevented by RFID technology. Laboratories are considered as the heart of healthcare systems because they are responsible for diagnosing the disease, in addition to controling and preventing the contagious and non-contagious diseases. No doubt, in the following years, along with the development in laboratories in the world, their places for patient care will be more highlighted (14). Given that, laboratory faults has become the main concern of diagnosing diseases which can lead to mistaken diagnoses, not suitable care, lag in treatment, faulty clinical research, higher cost, can eventually risk the patient's survival (15). The application of RFID in the laboratory department is tracking the medical supplies which are sensitive to the environment, such as blood bags (11). Also, based on Florentino et al., using RFID can lead to improving the quality and automation control in the clinical laboratories (16). Considering the importance of applying RFID in labratories and the neccesity of the staff awareness of the technology capabilities, this study was conducted to investigate awareness, attitudes, and skills of medical laboratory staff in Shiraz toward implementing RFID technology.

2. Materials and Methods

The current study was a cross-sectional study conducted based on the descriptive-applied approach in private and public medical laboratories in Shiraz in 2017. The population of this study included all

laboratories' staff that involved technicians, technologists, and technical supervisors. Hence, 147 staff were assigned through census with the attrition rate of 4% .

Data were collected using the researcher-made questionnaire. This questionnaire evaluated five components; demographic information(5questions),participants'skils (11 questions), awareness toward RFID (9 questions), attitudes toward RFID (11 questions), and finally, a Poll on infrastructures needed to implement RFID technology (5 questions). The answer options used in the skill and awareness part of the questionnaire were in the 5-point Likert-scale format (very low=1, low=2, mediocre=3, high=4, very high=5). The average score from one to two, shows the poor level of awareness, attitude and skill, and the average scores of 2-3 and 3-4 indicate the medium and good level of KAP, respectively, and finally the avarage between 4-5 means a very good level of staff, their awareness, attitudes and skill.

To confirm the face and content validity, the questionnaire was reviewed and approved by six healthcare management specialists of faculty member of Shiraz University of Medical Sciences. Cronbach alpha was used in evaluating questionnaire reliability. In this basis, a pilot study including 40 questionnaires was conducted. The reliability coefficient based on Cronbach alpha value was 0.821 which was approved (Cronbach alpha; attitud= 0.803, awareness= 0.785, and skill= 0.875). The participants' agreement on voluntarily filling in the questionnaire and their overall consent was also obtained. At the same time, it was mentioned that their data would be handled with strict confidentiality. Based on this, the questionnaires without names were dispensed among the participants. They completed it self-administrated, and the collected data was analysed using the IBM SPSS statistical package version 23. Hence, the data was analysed using descriptive indexes (mean and standard deviation) as well as analytical indexes (t-test, ANOVA and Pearson correlation coefficient) considering 5% as the level of significance.

3. Results

In this study, 36.73% of the respondents were male, and the rest were female. 78 respondents (53.06%) were older than 30 years, and 84 respondents (57.15%) indicated they had less than ten years of work experience. Concerning educational level, 72.79% (107) had bachelor degree, and 95 respondents (64.63%) were employed based on one-year contracts (Table1).

Table 1. Demographic information of medical laboratory staffs in Shiraz, 2017

Variables	Groups	Number	Percentage(%)
Age	Younger than 2o	0	0
	20-25	15	10.20
	25-30	54	36.74
	30 years old and older than 30	78	53.06
Sex	Male	54	36.73
	Female	93	63.27
Work experience	Less than ten years	84	57.15
	10-15 years	29	19.73
	15- 20 years	25	17
	More than 20 years	9	6.12
Education level	Associate degree	7	4.76
	Bachelor degree	107	72.79
	Master degree	29	19.73
	Ph.D	4	2.72
Employment type	One year contract	95	64.63
	Longer contract	9	6.12
	Official	32	21.77
	Obligatory Services	11	7.48

The findings of the current study showed that the average staff awareness and skill level were 3.13±0.91 and 2.39±0.65, respectively. Among awareness proxies, making the environmental changes for RFID implementation with the mean of 3.43±1.72 achieved the highest rank, and among skill proxies, the accuracy in controlling sampling with the mean 3.39±1.14 got the highest level (Table 2).

Table2. Level of skill and awareness of the public and private medical laboratories in Shiraz about RFID technology

Mean and Frequency of personnel skills score						
Components	very low (N)	low	Medium	high	very high	Mean±SD
ICDL skills	46	74	14	11	2	1.95 ± 0.90
RFID skills	51	81	8	2	5	1.83 ± 0.86
Working skills with HIS	36	78	26	6	1	2.04 ± 0.80
Barcoding laboratory samples skill	33	73	29	11	1	1.15 ± 0.88
Applied working experience with RFID	61	49	11	23	3	2.05 ± 1.14
Skills in applied RFID domains	64	49	6	8	20	2.13 ± 1.39
Accessibility to RFID technology	84	52	8	2	1	1.53 ± 0.72
Accuracy in controlling sampling in centres	8	32	24	61	22	3.39 ± 1.14
Satisfaction on sampling method in centres	10	31	26	53	27	3.38 ± 1.20
Staff confidence on sampling method in centres	8	32	22	64	21	3.38 ± 1.14
Staff confidence on sampling with RFID technology	23	67	26	20	11	2.52 ± 1.12

Mean and Frequency of staff awareness score						
Information centre level about RFID technology	27	32	72	16	0	2.53 ± 0.92
Existing the RFID technology perspective in the centre	20	15	45	65	2	3.07 ± 1.07
Centers' structural modification to execute RFID	18	14	56	32	27	3.22 ± 1.22
Implementing the hardware and Software of RFID	18	15	47	53	14	3.20 ± 1.15
Existing the system facilitator for employees	15	18	57	50	7	3.09 ± 1.04
Exisiting the appropriate infrastructures for information technology (ICT)	17	20	47	54	9	3.11 ± 1.10
Building a desirable culture to implement RFID system	21	20	58	39	9	2.95 ± 1.11
Environmental change to implement RFID system	22	13	42	45	25	3.43 ± 1.72
Cost- effectiveness of RFID	19	13	15	48	52	3.23 ± 1.25

The results also showed that the mean of participants` attitudes toward RFID was 4.09 ± 0.38, and among attitude proxies, the component "RFID technology leads to lower errors" with the mean of 4.17±0.54 got the highest rate (Table 3).

Table3. The medical laboratories' staff attitudes toward RFID technology in Shiraz

Mean and frequency of staff awareness of RFID technology						
Components	completely disagree	disagree	neutral	agree	completely agree	Mean± SD
Improving quality of care using RFID	0	1	15	116	15	3.98 ± 0.47
Continuty of care using RFID	0	1	17	96	33	4.09 ± 0.60
RFID technology lead to speed up the service delivery	0	1	11	96	38	4.16 ± 0.57
RFID technology encourage staffs working in the sampling area	0	3	26	75	43	4.07 ± 0.74
Adopting RFID technology by facilitating the fast access to the information leads to health continuity in the society	0	0	24	86	37	4.08 ± 0.64
RFID technology leads to lower the healthcare costs	0	3	43	71	30	3.86 ± 0.75
RFID technology leads to lower the the time of data entry.	0	2	15	90	40	4.00 ± 0.58
RFID technology leads to lower the error	1	4	5	91	45	4.17 ± 0.70
RFID technology increases the staff satisfaction	0	1	10	105	31	4.13 ± 0.58
RFID technology increases the patient satisfaction	0	1	10	104	31	4.13 ± 0.54
Implementing RFID technology is beneficial for patients	0	2	11	97	37	4.14 ± 0.70

Also, 87.76% (129) of the respondents had a positive attitude toward executing RFID technology (Table 4).

Table4. The overall attitude of medical laboratories' staff toward implementing RFID technology in Shiraz

Attitude toward implementing RFID technology	Frequency	Percentage
Positive	129	87.76
Negative	6	4.08
Neutral	12	8.16

Furthermore, in the section regarding the necessary infrastructures for RFID technology in Table 5, the proxy "staff resistance." got the highest mean (3.74±1.08). Overall, the results derived from this section indicated the poor infrastructures of these centres in implementing RFID technology (Table 5).

Teble 5. Medical laboratory staff attitudes toward necessary infrastructures in implementing RFID technology in Shiraz

Components	Yes (%)frequency	No (%)frequency	Mean± SD
Enough budget	141(95.91)	6(4.09)	3.62±1.27
The absence of staff resistance toward acceptance of RFID technology	142(96.59)	5(3.41)	3.74±1.08
Senior manager support	139(94.55)	8(5.45)	3.26±1.29
Necessary training	140(95.24)	7(4.76)	3.21±1.13
Suitable equipment	138(93.88)	9(6.12)	3.19±0.78

Based on the results of this study, there was found a significant direct correlation between the staff awareness, attitudes, and skills in laboratories ($P<0.05$) (Table 6).

Also, there was a significant relationship between staff awareness and attitudes with education level ($P<0.05$) (Table 7).

Table 6. Correlation between awareness, attitudes and skills in laboratory staff toward RFID technology

Dimensions	wareness	Attitude	Skill
Awareness	1		
Attitude	r = 0.550 p = 0.000	1	
Skill	r = 0.441 P = 0.000	r = 0.256 P =0.003	1

*Correlation is significant at the 0.05 level

Table 7. Relationship between awareness, attitudes and skills in laboratory staff toward RFID technology with demographic variables

Variables	Awareness	Attitude	Skill
Age	P= 0.11 r= 0.21	P= 0.26 r= 0.16	P= 0.08 r= 0.13
Sex	P= 0.56 t= 1.28	P= 0.19 t= 1.06	P= 0.31 t= 0.98
Work experience	P= 0.12 r= 0.36	P= 0.15 r= 0.18	P= 0.09 r= 0.26
Educational level	P= 0.01* F= 1.74	P= 0.03* F= 1.46	P= 0.12 F= 1.02
Employment type	P= 0.41 F= 1.01	P= 0.32 F= 0.87	P= 0.28 F= 1.15

*Correlation is significant at the 0.05 level

4. *Discussion*

Based on the findings of the current study, the laboratory staff skills toward RFID technology labelled medium. In this regard, the findings showed that variables, such as ICDL skills, the basic skills of working with RFID technology, and the accessibility of RFID system, all as proxies for skill variable were in poor level. In this vein, Ebrahimi et al. declared that the awareness level of Shiraz University of medical science hospitals in implementing

RFID technology was not acceptable, which may be due to the proficiency deficiency among managers and the staff of these centres (18). Furthermore, the components, such as HIS Software working skill, the laboratories sample barcoding skills, applied RFID working skills, and staff confidence level using RFID technology were estimated to be at a medium level.

The participants' awareness of RFID technology was also estimated at a good level. Among other variables within this dimension, the centre's information level about RFID technology and desirable culture to implement RFID system was assessed to be at a moderate level, which may be due to lack of enough attention to the information centres' responsibilities and building a desirable cultural foundation to pave the way for implanting RFID technology.

The findings also showed that the staff awareness toward RFID technology was positive and in good condition, which determined the laboratories' willingness in implementing this technology. In this sense, almost all participants believed that implementing RFID technology can lead to lower laboratory errors. Given the awareness level and positive attitude of the staff toward implementing RFID technology, this technology should take more of managers' attention to develop the staff skills. Taking this into account, we can step further by developing the intensive and specific training sessions about RFID technology by the University of Medical Sciences in the first run, which could then be followed by further attempt of vice chancellor for the education of ministry of health in order to improve skills regarding the role of RFID technology. In this regard,

it seems necessary that managers and seniors in healthcare system provide the preliminary arrangement to implement the demanded RFID technology, though this technology is not perceived to be complicated Accordingly, Dey et al.(2016), in their exploratory investigation of RFID technology adoption in the US hospitals reported that the high percentage of respondents adopt this technology as a new management tool. In this regard, organisational factors and technology have had a positive impact on their adoption (18), which can reflect their positive attitude toward RFID technology.

The results of the current study further showed that among the necessary substructures to implement RFID technology from the staff viewpoints, providing the condition in which the staff have not resisted in adopting this technology got the highest priority. It seemed that the novelty of this technology would be one of the potential reasons for their resistance. Sepehri and Mollabagher (2011) in their case study indicated that there was a close relationship between staff resistance and the perceived lack of confidence in using RFID technology (19). Besides, Tzeng et al., by evaluating the business value of RFID, found that one of the difficulties of implementing this system would be moderating personnel as a reason for the expansion of RFID technology, which is the major concern of employees (20). The study conducted by Fakhr (2016) indicated that in Iranian hospitals, security, privacy, and ethical barriers affect the implementation of RFID technology (21). Also, the study of Carr et al. showed that, despite the readiness of hospitals in implementing RFID technology, they suffered from their poor infrastructure to

implement RFID which was a big challenge(22). The findings of a study conducted by Lopez et al. showed that even though RFID technology may help to increase personnel efficiency and ease the work conditions for healthcare professionals, plus sorting patient records out in a good and precise order, the costly initial investment for implementing this technology, plus the timely learning process seem to be a major challenge. In this respect, any development in technology implementation could be linked to the importance of infrastructure (12). Fischer and Monahan also mentioned the inappropriate physical and technological infrastructure as the main challenge in implementing RFID technology in hospitals (5).

Eventually, our study findings showed that there was a significant and positive correlation between staff awareness, attitudes, and skills variables in the sense that any raise in awareness level caused the other two variables namely, attitude and skill also to increase. Thus, through precise planning, learning process, and obtaining information about RFID technology, we can take a step further to increase the respondent awareness.

This study yet suffered from some limitations, such as lack of similar, relevant, and recent studies, which could be comparable and in line or not in line with our results.

Based on the study results, the overall staff awareness of RFID technology was positive. Considering the inchoate RFID technology in a healthcare setting, it then seems that the healthcare staff have not yet had an adequate affinity with this technology and its benefits, so they were sceptical whether to use it. At the same time, the healthcare managers were not quite familiar with RFID technology while supporting it, which then led to the staff's reluctance to use it. So, to be aligned with the technological world, we should integrate new technological advancement into our system, while negligence of that can cause a severe threat to the healthcare industry of our country. Considering all these issues, we suggested that laboratory managers and staff should get a better understanding of information technology and its merits through online training sessions, workshops, and academic conferences, which could then in return develop their knowledge, awareness, willingness, and eventually skill. In this regard, other ways of improving awareness and skill like pamphlet, training brochure could be of great help. It was also evident that in some centres, healthcare staff have not acquired enough skills which could be due to the centre's Policy codification. These policies have not encompassed information technology.

Conflict of interest

The authors declare that there is no conflict of interest.

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