

## The assessment of Picture Archiving and Communication System based on Canadian Infoway PACS Opinion Survey in Teaching Hospitals of Shiraz University of Medical Sciences

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### ABSTRACT

**Introduction:** Today the use of information technology in accordance with the rapid environmental changes and flexibility acquisition is necessary and unavoidable. Picture Archiving and Communication System (PACS) is one of the medical information technology used in health facilities. PACS provides the images archive and transmission possibility electronically in different units of the teaching and treatment centers. This study aimed to assess the PACS system in teaching hospitals of Shiraz University of Medical Sciences based on a survey of Canadian Infoway.

**Method:** This descriptive cross-sectional study was performed on 53 individuals selected through Two-Stage Stratified Random Sampling. The study population consisted of 156 PACS users in Shiraz University of Medical Sciences hospitals which were equipped with the PACS system in 2015. Data were collected by the valid and reliable customized questionnaire of Canadian Infoway. The reliability was measured by a pilot study on 25 PACS users; Cronbach's Alpha was estimated 0.78. Data were analyzed using SPSS 18. Also, frequency, mean, standard deviation were used.

**Results:** The results are presented in three sections: environment (Background Variables), benefits and challenges of PACS. As to the system availability, 20.8% of the users in the clinic, 75.5% in the diagnostic imaging department, only 3.8% in offices had access to the PACS. As to system accessibility, 49.1% of the users just had access to tests, 5.7% only to the reports, and 45.3% to both reports and tests. With respect to benefits of PACS, the mean was 4.16 (SD: 0.5) (five-point scale 1-5) estimated, and in challenges, the mean was 3.48(SD: 0.5) (five-point scale 1-5).

**Conclusion:** The results showed that although PACS could eliminate many restrictions concerning the use of radiology images and films, there were challenges in this regard. Users are recommended to have access to PACS in all clinics, physicians' offices, and diagnostic imaging department. The majority of users agreed with the PACS benefits. Adequate management measures must be taken to maximize the benefits derived from this system and the utilization of information in order to improve the quality of care. Adequate training and elimination of the deficiencies could affect the use of this system and improvement in the health care services.

**Keywords:** PACS, Picture Archiving and Communication System, Assessment, Infoway

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### Introduction

The use of information technology is necessary and inevitable considering the rapid environmental changes and reach the required flexibility (1). Information and communication technology revolution has had remarkable effects on all sectors of economic, social, political and national security. One of the most important fields of information technology application is health system (2). Research literature shows that information technology should be properly used to make the best decisions, and produce knowledge and used it in the field of health (3). The application of information technology in the health industry, particularly in hospitals and medical centers, has created enormous potential to improve the quality

of health care services (4). One of the applications of medical information technology is in the radiology department (5). Now imaging technology, storage, viewing and communication have considerable progress and digital radiology can be considered as one of the recent developments. A digital radiology department is made of two basic parts: radiology information system and the digital images (6). Radiology information system is a subset of hospital information system that stores the patients' information, while the pictures archiving and communication system will connect with the digital images (7). PACS system provides the possibility of storing and sending medical images electronically in different training and treatment centers. It can save

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and recall images obtained from various methods of diagnostic imaging, such as MRI (Magnetic Resonance Imaging), CT scan (Computed Tomography), ultrasound, radiography, angiography, nuclear medicine, etc. in the form of digital images (8). Medical picture archiving and communication system performs processing, archiving and transferring images differently compared to what was in the past (6). By using digital radiology, the time distance between the order and delivery of the final image is reduced (9). The benefits of this system are keeping the patient's diagnostic procedure records (CT, MRI ...) for several years with higher quality and better understanding from the pathology, enjoying the possibility of reporting and diagnosis by specialists without physical presence in the center, reaching the diagnosis of the disease by the physician using image processing technology, retrieving the images easier, reviewing the images easier, having more access to images, observing the images in multiple sites simultaneously, and having the possibility of better time management.

Also, by the film removal in digital radiography, X-ray film costs, film processing medications, purchase and installation of equipment such as video processing device (processor) and environmental pollution due to X-ray film are reduced; this significantly reduces the costs and increases the speed in diagnostic operation (10). According to Mansoori, successful implementation of PACS improves the radiology efficiency, reduces the final report turnaround time, almost eliminates the film costs, and contributes to the reduction of labor costs (11). At the end of 2008, Canada invested about 310 million dollars for PACS implementation. The result of Rainer's research showed 2.16% reduction in the interpretation time when using PACS in comparison to the film (12).

Researches performed on PACS in ICU in 2002 revealed that 94% of the ICU staff believed that it improves the overall service and 90% expressed quicker access to images in PACS environment than the film environment. 80% of physicians believed that clinical decision making in PACS was faster than film (13). According to these results, investment in the radiology development toward digital and electronic management leads to better care, more efficiency and more cost-effectiveness (14, 15). In the Lewis's study, 79% of the users considered PACS better than hard copies and 83% recommended its use. Some problems such as lack of education, lack of good quality of the images, and lower monitor's quality were also reported (16). In a research performed by MacDonald et al. in 2010, most of the physicians recommended that the time of reviewing the images should be reduced and the care opportunities in rural areas should be increased; the lowest support was related to the patient's length of stay. The system's challenges were reported viewing photos at the bedside, having no support system, and the images' low quality in the physicians' network. Radiologists also announced that reduction of the images' review time, improvement of the report, and quality of the photos were the advantages of the system (17). Advent of digital and advanced medical equipment and medical sciences necessitated a movement in the use of software; also,

the hospitals need to move toward integrating the health information and take basic steps in the use of information technologies in hospitals (18). However, in our country, except a few hospitals that use PACS system primarily, the other hospitals have not been equipped with this system. One of the reasons for lack of enough attention to this important point by the hospital authorities is the high cost of the system and its implementation and the fear of failure to capital return financially or work facilitate and efficiency and effectiveness increasing. Assessment studies can estimate the system's challenges and benefits while implementing the users' opinions and experiences about the systems for others with more confidence. The present study aimed to assess the PACS from the users' point of view in teaching hospitals of Shiraz University of Medical Sciences which, at the time of research, were equipped with this system.

### Methods

This research is descriptive cross-sectional study that was conducted in 2015 on 156 PACS users in Nemazi, Faghihi, Shahid Chamran, Shahid Rajaei hospitals and Motahari clinic. These hospitals had been equipped with PACS at the time of research. 53 individuals were determined by using Two-stage Stratified Random Sampling according to the following formula in the significance level of 0.05, the standard deviation of 0.5, and precision of 0.11. The first and second strata were the above mentioned hospitals and the users respectively. 30% of the users in each hospital were selected by simple random sampling from Random-number table.

$$\left( n = \frac{z_{1-\frac{\alpha}{2}} \cdot \sigma S^2}{d^2} \right) = 53$$

The data gathering tool was Canadian Infoway questionnaire that was originally prepared in English and then translated into Persian via back-translation method. Content validity was approved by 5 experts in the PACS field and information management, and minor changes were conducted. The reliability of the instruments was obtained through a pilot study on 25 samples selected randomly from each hospital. Cronbach's Alpha for the total questionnaire was 0.78; in addition, the measurement of Alfa for each dimension showed that the employees did not have any difficulty understanding the questionnaires items. Therefore, no specific changes were made in the questionnaire. The questionnaire consists of three parts. The first part contains information about the background variables, such as work experience and duration of work with PACS (Question 1-2), PACS environment (Question 3-4) that was related to the system access and system access places. The second part is about the PACS benefits including 5 to 16 questions and the third and fourth parts were PACS challenges including 17 to 29 questions in the questionnaire. We used the Likert five-point scale: c benefits part "5= strongly agree" to "1= strongly disagree" and in the challenges part, "5= strongly disagree" to "1= strongly agree". The higher scores in this part indicate

that these items are not considered as a challenge. Data were analyzed using SPSS 18 Software. Descriptive statistics (frequency, mean, standard deviation) were used to summarize the demographic characteristics.

## Results

Results were investigated in three sections: environment (background variables), PACS benefits, and challenges. Median, mean, standard deviation and variance of questions relating to work experience, use of the system duration, availability and accessibility (Background Variables) are presented in Table 1.

52.8% of the users had less than 5 years and 1.9% had over 25 years of work experience. 3.8% of the users had used the PACS system for 6-10 years and 58% of them for 2-5 years. As to the system availability, 20.8% of the users in the clinic, 75.5% in the diagnostic imaging department, and only 3.8% in their offices could have access to the system. Also, 49.1% of the users just had access to the test, and only 5.7% to the reports.

**Table 1.** The users' background, availability and accessibility to PACS

Variables		Frequency	Percent
Work Experience	≤10	36	67.9
	11-20	12	22.6
	≥21	5	9.5
Using of system duration	Under 2 year	20	37.7
	2-5	30	58.5
	6-10	2	3.8
System availability	Clinic	11	20.8
	Diagnostic imaging department	40	75.5
	office	2	3.8
System accessibility	access to test order	26	49.1
	access to reports	3	5.7
	access to reports and tests order	24	45.3

Table 2 shows that all of the users believed that the PACS reduced the time spent for finding the images and improved the access to previous .About the Improve the number and patient rounds management quality 22.6 % were neutral and others agreed. 22.6 % of users with highest frequency had disagreed that PACS facilitate face to face consultation between the patient, doctors and radiologists. And the lowest percentage (39.6 and 20.8) belonged to the provision of remote reporting for new and previous locations. As to reduction of the time spent for business travels and improvement in training of medical students and residents of radiology respectively 9.5 and 5.7 % of the users did not agree, 66 and 79.2% agreed, and the others were neutral.

Table 3 shows the users' point of view about PACS challenges. 64.1% of PACS users (highest frequency)

believed that the management in implementation/ installation and system transformation from film environment to PACS was inadequate, and the lowest percentage of them agreed (9.6 and 15.6, respectively) agreed with inadequate PACS functionality and inadequate image quality on the workstation. With regard to the problem in finding pictures on time and the problems in logging into the system respectively 73.6 and 68% of the users disagreed, 19.2 and 21.2% agreed, and the others were neutral; moreover, 52.8% of the users were dissatisfied with inadequate training in the field of PACS technology.

## Discussion

Given that the health care system users are directly or indirectly involved with these systems, they have valuable knowledge about informational systems' processing. Therefore, their viewpoints can substantially contribute to the assessment of these systems. The research results showed that all of the PACS users agreed with reduction in the time spent for finding images and more access to the previous images; also, most of the users agreed with benefits such as the quality of the patient rounds management, facilitation of the face to face consultation, provision of remote reporting for new and previous locations, reduction in the time spent for business travels and improvement in training of medical students and residents of Radiology. This result is in the same line with Mansoori (2011) (11), MacDonald (2010) (17), Reiner (2001) (12), and Cox and Dawe's studies (2002) (13). These studies suggest that the benefits of the system including reduction of final report turnaround time, elimination of films costs, reduction of labor costs, reduction of interpretation time, overall improvement in services, faster access to photos, reduction in the time needed for investigating the photos, improvement in reporting and quality of photos, and Increase in care opportunities in rural areas. On the other hand, Mac Donald (17) explains that checking photos on the bedside, lack of the system support, and low quality images in medical network are the challenges of this system.

Frequency score in PACS challenges dimension showed almost the majority of users disagreed with challenges such as inadequate image quality on the remote Web, inadequate image quality on the workstation, inadequate PACS functionality on the workstation, inadequate PACS functionality on the remote Web, problems in finding the images on time, inadequate remote Web performance(speed), inadequate access to PACS viewing stations, problem in logging into the system, and prolonged system down time due to technical fault. This result is in contrast with those of MacDonald (2010) (19), Lewis (2010) (16), and Tana (2010) (16). These studies suggest that the challenges of the system including insufficient training, uncertainty, low photos quality, lack of viewing the photos at the bedside, lack of system support, reduction in face to face communication with other doctors, insufficient speed of the Web, and lack of quality images. Also, these result are not in the same line with Splawinski (2006) (20), Paskins(2005) (18), and Gholamhosseini's findings

Gholamhosseini's findings (2011) (21). Splawinski (20) indicated that when a consultation with outside of institution is to be conducted, the time spent with PACS is more than reviewing a simple film. This opposition may be related to connection lines, speed of connection lines and firewalls. Paskins (18) and Gholamhosseini (21) mentioned that twothirds or more users were not able to retrieve information and were not satisfied with this process.

More than half of users agreed with inadequate training in the field of PACS technology and inadequate management in implementation/installation and system transformation from film environment to PACS challenges. These results agree with those of Lewis (2010) (16) and See Ling Tana's findings (2010) (16). Lewis mentioned insufficient training was one of the PACS challenges (16).

The results indicated that the PACS eliminates many restrictions concerning the use of radiology images and films such as the time spent to retrieve the images, report turnaround time, etc. Since the majority of users confirmed the inadequate management in implementation/ installation and system transformation from the film environment to PACS, adequate management measures must be taken to maximize the benefits derived from this system and utilize the information in order to improve the quality of care.

#### Conclusion

As the results showed, although PACS could eliminate many restrictions concerning the use of radiology images and films, there are many challenges in this regard. Users' access to PACS in all clinics, physician offices, and diagnostic imaging departments should be provided. The majority of the users agreed with the PACS advantages.

**Table 2.** The users' point of view about PACS benefits

Row	Benefits Questions	Strongly disagree (%)	Disagree (%)	neutral (%)	agree (%)	Strongly agree (%)
1	Reduce the time spent for finding picture	0	0	0	18.9	81.1
2	More access to the previous pictures	0	0	0	7.5	92.5
3	Improve reports return time	0	1.9	9.4	35.8	50.9
4	Improve report quality	0	0	7.5	28.3	64.2
5	Improve the number and patient rounds management quality	0	0	22.6	32.1	45.3
6	Facilitate face to face consultation between the person, doctors and radiologists	15.1	7.5	11.3	32.1	34.0
7	Reduce the time spent for business travels	3.8	11.3	18.9	35.8	26.4
8	Improve training of medical students and residents of Radiology	5.7	3.8	22.6	30.2	35.8
9	Provide remote reporting for previous locations	3.8	1.9	15.1	28.3	50.9
10	Provide remote reporting for new locations	7.5	3.8	28.3	30.2	30.2
11	Improve consultations and reports efficiency	9.4	1.9	32.1	17.0	34.0

**Table 3.** Users' point of view about PACS challenges

Row	Challenges Questions	Strongly disagree (%)	Disagree (%)	neutral (%)	agree (%)	Strongly agree (%)
1	Inadequate image quality on the remote Web (e.g. from home)	18.9	34.0	20.5	20.8	5.8
2	Inadequate image quality on the workstation	52.8	28.3	3.8	13.2	1.9
3	Inadequate PACS functionality on the workstation	39.6	43.4	7.4	9.6	0
4	Inadequate PACS functionality on the remote Web	20.8	35.8	24.4	13.2	5.8
5	The problem in finding on time Pictures	39.6	34	7.2	17.3	1.9
6	Inadequate remote Web performance(speed)	32.1	20.8	18.8	15.1	13.2
7	Inadequate workstation performance(speed)	34	28.3	17	13.2	7.5
8	Inadequate access to PACS viewing stations	28.3	30.2	20.7	18.9	1.9
9	The problem in log in to the system	34	34	10.8	13.5	7.7
10	Prolonged system downtime due to technical fault	20.8	34	18.8	15.1	11.3
11	Inadequate training in the field of PACS technology	28.3	18.9	0	28.3	24.5
12	Inadequate support in availability of system	19.2	19.2	12.6	22.6	26.4
13	Inadequate management in implementation/ installation and system transformation from film environment to PACS	7.5	13.2	15.2	35.8	28.3

Adequate training and the elimination of the deficiencies could affect the use of this system and improve the health care services.

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### Conflict of interest

none declared.

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