RESEARCH ARTICLE

Communicating laboratory results through a Web site: Patients' priorities and viewpoints

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Background: Patients can access laboratory results using various technologies. The aim of this study was to integrate the laboratory results into the hospital Web site based on patients' viewpoints and priorities and to measure patients' satisfaction.

Methods: This descriptive-analytical study was conducted in 2015. First, a questionnaire was distributed among 200 patients to assess patients' priorities to receive laboratory results through the Web site. Second, those who agreed ($n = 95$) to receive their laboratory results through the Web site were identified. Then, the required changes were made to the hospital Web site based on patients' viewpoints and priorities. Third, patients were divided into two groups. The first group received their laboratory results through the Web site on the date had been announced during their visit to the laboratory. The second group was informed by SMS once their results were shown on the Web site. After receiving laboratory results, patients' satisfaction was evaluated.

Results: More than half of the participants ($n = 53$, 55.8%) were highly satisfied with receiving the results electronically. The higher number of people in SMS group ($n = 9$, 20.9%) reported that they were satisfied with time-saving compared to other group ($n = 2$, 3.8%) ($P = .04$). Participants after receiving the results through the Web site considered the functionalities of reprinting ($P < .0001$) and timeliness ($P = .017$) more important.

Conclusion: Integrating laboratory results into the hospital Web site based on the patients' viewpoints and priorities can improve patient satisfaction and lower the patients' concern regarding confidentiality of their results.

KEYWORDS

clinical laboratory information systems, laboratory automation, online systems, patient portals, patient satisfaction, system evaluation

1 | INTRODUCTION

One of the applications of communication and information technology in the health sector is providing online health services. Patients want to have online access to their health information and services,^{1,2} and they believe it improves their self-care³⁻⁷ and save their time.^{4,8,9} Some studies showed that patients like to use Internet-based technologies and to have better access to laboratory results.¹⁰⁻¹³ Making use of information and communication technology

in a laboratory department can improve test management processes.¹⁴⁻¹⁶ Moreover, using information technologies establishes integrity and strengthens the relationship between health providers and patients.¹⁷ Patients can access laboratory results using various technologies. Results of different studies indicated that electronic systems can access laboratory database and generate email, SMS, etc., to inform patients about their normal and abnormal laboratory results. Likewise, patient can access their results through a portal.^{18,19} Christensen²⁰ showed that patients are very satisfied with

receiving their laboratory results through a portal. Similarly, results of a study conducted by Giardina²¹ showed that patients prefer to receive their abnormal laboratory results through a portal. However, results of some other studies revealed that providing patients with online laboratory results can raise their concerns regarding information confidentiality.²²⁻²⁴ Besides, problems related to health and computer literacy were other concerns related to online communication of laboratory results.²¹ Some other concerns are negative emotional reaction of patients when they receive their abnormal laboratory results and inability to understand normal and abnormal results that require a physician to explain the results.^{14,25-27}

On the other hand, in some studies, failure to follow up laboratory results is identified as a major safety issue in outpatient centers.^{28,29} To solve this problem, using communication technologies is of great importance.³⁰ However, there is no guideline concerning how and when patients must be informed about their laboratory results.^{31,32} Thus, one solution to increase patients' satisfaction and decreasing patients' concerns is to collect patients' viewpoints and priorities and to involve them in developing online communication system to receive laboratory results. In Iran, there is no comprehensive guideline about communicating laboratory results through hospital Web site and there are few laboratories which use this method to communicate the results. Hence, patients go directly to the laboratories for their results. Moreover, no study has evaluated online laboratory results in Iran.³³ Studies conducted in other parts of the world have evaluated patients' viewpoints and satisfaction about online laboratory results.^{20,34,35} Therefore, the objective of this study was to integrate laboratory results into the Web site of Shahid Chamran Hospital in Ferdows, Iran, based on patients' viewpoints and priorities and to evaluate patients' satisfaction and viewpoints before and after launching this portal.

2 | METHODS

This descriptive-analytical study was conducted in 2015 at Ferdows University Hospital where a wide range of laboratory tests are performed. The inclusion criteria for inviting participants were (i) having access to the Internet and (ii) visiting hospital laboratory at least once to have attest.

This study was conducted in three phases. In the first phase, a questionnaire was used to collect patients' preference and priorities to receive laboratory results through the Web site. In this phase, a questionnaire was distributed among 200 patients estimated based on Cochran's sample size estimation who were selected randomly. In this phase, participants reported on their preferences regarding receiving laboratory results. In the second phase, patients who agreed to receive their laboratory results through the Web site were identified. As 95 participants agreed to receive their results through Web site, the study was conducted on these participants. Then, the required changes were made to the hospital Web site based on patients' views collected in the first phase. Besides integrating the laboratory results into the

hospital Web site, for each patient the data that he had selected to receive along with their results were uploaded to the hospital Web site and patient could download their results with the requested data. Moreover, patients could print their results and if required, reprint them at any time. For the security of results, we gave a username and password to every patient to access his/her own results. The admission number written on the patient's bill was used as a username, and the patient's national ID number was used as a password. In the third phase, all 95 patients who agreed to receive their laboratory results through Web site were divided into two groups ($n = 42$ and 43). The first group received their laboratory results through the hospital Web site on a predetermined date that had been announced during their visit to the laboratory. Patients in the second group were notified by SMS once their results were shown on the Web site. All 95 patients were divided randomly based on the information received in the first phase. Using an electronic questionnaire, we assessed patient's satisfaction after receiving the laboratory results through the Web site.

Two questionnaires were used in this study. Questions designed in these questionnaires were a combination of researcher-made questions and questions obtained from other studies.^{22,36-38} Four medical informaticians (experts in the domain of medical and health information management) confirmed the content validity of the questionnaires. The reliability of the questionnaires was confirmed using test-retest recruiting 20 participants, $r = .8$.

2.1 | The first questionnaire

This questionnaire collected patients' viewpoints and priorities before designing the Web site. This questionnaire consisted of 23 questions in three parts. The first part was related to the demographic information; the second part was related to using information and communication technology; and the third part evaluated patients' viewpoints and priorities in relation to presenting laboratory results through the Web site and SMS.

2.2 | The second questionnaire

This questionnaire which was designed electronically examined patients' viewpoints after receiving laboratory results through the Web site. This questionnaire consisted of 12 questions in two parts. Part I evaluates patients' satisfaction with the following aspects: ease of access, confidentiality, cost and time-savings, and overall satisfaction. Part II examines time spent to receive results through the Web site and evaluating patients' satisfaction using SMS. Some questions from the first questionnaire were used again after the intervention. Data were analyzed by SPSS version 19 and R version 3.2.2 using descriptive and analytical statistics such as Mc Nemar, marginal homogeneity, chi-square, and marginal independence. Patient's agreement to complete the questionnaires was considered as their consent. This study was approved by the Research Ethics Committee of Kerman University of Medical Sciences (IR.KMU.REC.1394.379).

3 | RESULTS

The demographic information of the participants in pre-implementation phase (before sending laboratory results to the hospital Web site) showed that most of the people in the SMS group were 30 years old or younger ($n = 22$, 51.2%); the majority of them had a high school diploma ($n = 16$, 37.2%), were married ($n = 35$, 81.4%), and were housewives ($n = 17$, 39.5%). Moreover, most of them lived in Ferdows ($n = 25$, 58.1%). The demographic information of the group that did not receive an SMS was as follows: they were 30 years old or younger ($n = 25$, 48.1%); most of them had a bachelor's degree ($n = 17$, 32.7%), were married ($n = 39$, 75%), and were employees ($n = 19$, 36.5%). Most of them lived in the city ($n = 34$, 65.4%) (Table 1). The analysis of demographic data indicated that there was no significant difference between two groups in terms of demographic information ($P > .05$).

In this study, all patients had access to the Internet. About half of the patients ($n = 45$, 47.4%) spend less than thirty minutes per day on the Internet. Most of the participants ($n = 59$, 62.1%) used the Internet to access social networks. Majority of participants had Internet access at home ($n = 75$, 78.9%). Thirty-nine percent of them ($n = 37$) stated that they had access to the hospital Web site and mostly visited the Web site to see the physicians' schedules ($n = 25$, 69.4%). All participants had their own cell phones, and all knew how

to use SMS. Forty percent ($n = 39$) of people stated that they receive 3-5 text messages every day (Table 2).

The majority of patients stated that receiving the results through the Web site saves their time ($n = 72$, 75.8%); 64.2% ($n = 61$) believed that it reduces costs and transportation problems; 44.2% ($n = 42$) were interested in electronic availability of the results; and 32.7% ($n = 31$) enjoyed the reduction in problems related to missing test results. Moreover, most people were willing to receive their normal and abnormal test results via Web site ($n = 73$, 76.8%), while 18.9% ($n = 18$) wanted to receive only their normal test results and 4.2% ($n = 4$) only their abnormal test results.

The analysis of postimplementation phase (after providing laboratory results through the hospital Web site) revealed that more than one-third of the participants were highly satisfied with the Web site because of savings in the costs ($n = 39$, 41.1%); 40% ($n = 38$) had partial satisfaction; and 9.5% ($n = 9$) had low satisfaction.

Concerning time-savings, more than half of the participants were highly satisfied ($n = 56$, 58.9%), 27.4% ($n = 26$) were somehow satisfied, 11.6% ($n = 11$) were completely satisfied, and 2.1% ($n = 2$) were a little satisfied.

Concerning ease of access after receiving the results through the Web site, most of the participants were highly satisfied ($n = 56$, 58.9%), 20% ($n = 19$) were somehow satisfied, 20% ($n = 19$) were completely satisfied, and 1.1% ($n = 1$) were a little satisfied.

TABLE 1 Demographic information of the participants

	Frequency (%)			
Variables	All Respondents	SMS group	No SMS group	P-value
Age				
≤30	47 (49.5)	22 (51.2)	25 (48.1)	.734
31-40	24 (25.3)	10 (23.3)	14 (26.9)	
41-50	15 (15.8)	8 (18.5)	7 (13.5)	
>50	9 (9.4)	3 (7)	6 (11.5)	
Education				
Diploma	30 (31.6)	16 (37.2)	14 (26.9)	.656
Associate Degree	24 (25.3)	12 (27.9)	12 (23.1)	
Bachelor of Science	31 (32.6)	14 (32.6)	17 (32.7)	
Postgraduate	10 (10.5)	1 (2.3)	9 (17.3)	
Marital status				
Married	74 (77.9)	35 (81.4)	39 (75)	.455
Single	21 (22.1)	8 (18.6)	13 (25)	
Occupation				
Employee	32 (33.7)	13 (30.2)	19 (36.5)	.11
Housewife	33 (34.7)	17 (39.5)	16 (30.8)	
Other	30 (31.6)	13 (30.3)	17 (32.7)	
Residential area				
Ferdows city	59 (62.1)	25 (58.1)	34 (65.4)	.469
Other cities	36 (37.9)	18 (41.9)	18 (34.6)	

TABLE 2 Responses of participants to questions about the use of technology for communication

Variable	Frequency (%)
Duration of the Internet use	
<30 min during the day	45 (47.4)
30-60 min during the day	18 (18.9)
60-180 min during the day	17 (17.9)
>180 min during the day	15 (15.8)
Tasks done through the Internet ^a	
Working affairs	35 (36.8)
Online purchase	26 (27.4)
Learning	45 (47.4)
Health information seeking	22 (23.2)
Social networks	59 (62.1)
Others	8 (8.4)
The access location for the Internet use ^a	
Home	75 (78.9)
Work	27 (28.4)
The net centers	29 (30.5)
Friends' houses	24 (25.3)
Universities	3 (3.2)
Tasks done through the hospital Web site ^a	
Check the working schedule of the doctors	25 (69.4)
Receive hygienic and health information	17 (47.2)
Research	1 (2.8)
Number of SMS	
1-2	13 (13.7)
3-5	39 (41.1)
6-8	23 (24.2)
>8	20 (21.1)

^aParticipants could select more than one option.

About half of the participants ($n = 44$, 46.3%) were highly satisfied with the confidentiality of laboratory results in the Web site. Also, 44.2% ($n = 42$) were somehow and 9.5% ($n = 9$) were completely satisfied with confidentiality. Total satisfaction of the patients with

receiving the results through the Web site was very high ($n = 53$, 55. %); only 1 participant (1%) was less satisfied with this method compared to the previous method of delivering laboratory results.

In this study, almost half of the subjects ($n = 43$, 45.3%) received SMS; 95.3% ($n = 41$) of them were completely satisfied with informing by SMSs. Compared to the SMS group, in the group receiving no SMS more people were satisfied with the Web site due to savings in costs ($n = 30$, 57.7%, $n = 9$, 20.9%, $P < .0001$). Moreover, more people in the SMS group than in the other group were satisfied with time-savings ($n = 9$, 20.9%, $n = 2$, 3.8%, $P = .04$). Total satisfaction of this group was also higher ($n = 18$, 41.9%, $n = 11$, 21.2%, $P = .011$) (Table 3). More people in the SMS group spent less than 5 minutes to receive online results ($n = 26$, 60.5%, $n = 6$, 11.5%, $P < .0001$), compared to no SMS group.

After receiving the results online, more people in the SMS group significantly acknowledged timeliness ($n = 50$, 96.2%, $n = 36$, 83.7%, $P = .0046$) and the availability of information such as physicians' name ($n = 31$, 72.1%, $n = 20$, 38.5%, $P = .0015$) (Table 4).

In addition, reprinting ($P < .0001$) and timeliness ($P = .017$) existence of some information such as physicians' name ($P = .024$) and the date of laboratory results (0.021) were considered more important after receiving the results through the Web site. After receiving the results, more participants ($n = 80$, 84.2%, $n = 50$, 52.6%, $P < .0001$) stated that receiving the results through the Web site was very effective (Table 5).

4 | DISCUSSION

The results of this study showed that most participants were highly satisfied with providing laboratory results through hospital Web site due to savings in time and costs and ease of access. About half of the subjects were highly satisfied with the confidentiality of the information they received. Moreover, most patients considered SMS reminders about provision of their laboratory results very helpful. To increase patients' satisfaction, all patients' priorities were considered in integrating laboratory results into the hospital Web site. In addition, all patients were carefully trained about how to retrieve laboratory results via the Web site. Sending out the laboratory

TABLE 3 Patients' satisfaction regarding receiving results via Web site

Variable ^a	Satisfaction level								P-value
	SMS group				No SMS group				
	Low n (%)	Partial n (%)	High n (%)	Very high n (%)	Low n (%)	Partial n (%)	High n (%)	Very high n (%)	
Cost savings	9 (20.9)	21 (48.8)	9 (20.9)	4 (9.3)	0 (0)	17 (32.7)	30 (57.7)	5 (9.6)	P < .0001
Time-saving	0 (0)	11 (25.6)	23 (53.5)	9 (20.9)	2 (3.8)	15 (28.8)	33 (63.5)	2 (3.8)	.04
Ease of access	1 (2.3)	7 (16.3)	25 (58.1)	10 (23.3)	0 (0)	12 (23.1)	31 (59.6)	9 (17.3)	.557
Confidentiality	0 (0)	24 (55.8)	16 (37.2)	3 (7)	0 (0)	18 (34.6)	28 (53.8)	6 (11.5)	.054
Overall Satisfaction	0 (0)	6 (14)	19 (44.2)	18 (41.9)	1 (1.9)	6 (11.5)	34 (65.4)	11 (21.2)	.011

^aGroups were compared using the chi-square test.

TABLE 4 The comparison of patient's viewpoints regarding preferable data and features of communication method between two groups

Variable	SMS group n (%)	No SMS group n (%)	P value
Selected features ^a			
Confidentiality of data	35 (81.4)	29 (55.8)	.0046
Possibility of reprinting	32 (74.4)	30 (57.7)	
Timeliness	36 (83.7)	50 (96.2)	
Preferable data for reporting along with the test result ^a			
Admission code	29 (67.4)	35 (67.3)	.0015
Demographic data	27 (62.8)	16 (30.8)	
Doctor's name	31 (72.1)	20 (38.5)	
ID number	27 (62.8)	37 (71.2)	
Other (e.g, date of the test)	7 (16.3)	8 (15.4)	
Used time ^b			
<5 min	26 (60.5)	6 (11.5)	<.0001
5-15 min	10 (23.3)	33 (63.5)	
15-30 min	7 (16.3)	13 (25)	

^aParticipants could select more than one option. Groups were compared using the marginal independence test.

^bGroups were compared using the chi-square test.

results on time improved patients' satisfaction. Results of several studies confirm that presenting results online is cost-effective,^{39,40} reduces transportation costs,²² and decreases waiting time for the patients.⁴¹

Woywodt⁴² in a study used a Web-based system to access the laboratory results of renal patients. The results showed that 53%

TABLE 5 Patients' viewpoints regarding preferable data and features of communication method before and after receiving the results via Web site

Variables	Before n (%)	After n (%)	P-value
Selected features ^a			
Confidentiality of data	66 (69.5)	64 (67.4)	.832
Possibility of reprinting	33 (34.7)	62 (65.3)	<.0001
Timeliness	74 (77.9)	86 (90.5)	.017
Preferable data for reporting along with the test result ^a			
Admission code	62 (65.3)	64 (67.4)	.855
Demographic data	41 (43.2)	43 (45.3)	.85
Doctor's name	35 (36.8)	51 (53.7)	.024
ID number	65 (68.4)	64 (67.4)	1
Other (e.g, date of the test)	5 (5.3)	15 (15.8)	.021
Efficiency of receiving results ^b			
Less	1 (1.1)	1 (1.1)	<.0001
Somehow	44 (46.3)	14 (14.7)	
Very much	50 (52.6)	80 (84.2)	

^aParticipants could select more than one option. Groups were compared using the Mc Nemar's test.

^bMarginal homogeneity test was used to compare the results.

of the patients were satisfied with the Web-based system to access their results. In addition, 93% of patients believed that this system would help them improve their conditions. Results of a study by Christensen²⁰ about patient's reaction after seeing their online laboratory results in a portal showed that a high percentage (72%) of patients were satisfied with the portal. In a study conducted by Mák⁴³ in Canada, it was shown that most patients were satisfied with receiving Web-based laboratory results.

In the present study, most people in the SMS group spent less time to receive their results via the Web site, compared to the no SMS group. In addition to reminding patients of visiting the Web site, SMSs provided participants with their usernames and passwords. It seems that these reminders resulted in patients to spend less time to receive their results.

Some studies conducted on the applications of SMS reminders in the health sector showed the significant effect of SMS missing appointments at healthcare centers.⁴⁴⁻⁴⁶ Similarly, results of a study by Car Ji⁴⁷ showed that SMS reminders increased the presence of patients in healthcare appointments compared to those who received no reminders. In this study, most participants significantly acknowledged timeliness (receiving the results on time) as an advantage of receiving the results via the Web site. Since receiving timely laboratory results can improve medical diagnosis and adherence to, healthcare institutions should invest on developing online delivery of the results.

In the study by Baldwin,²⁴ patients preferred to receive normal laboratory results. He reported that timeliness, confidentiality, interactive feedback, convenience, and provision of details were the most important characteristics mentioned by the participants.

In this study, confidentiality received less priority by patient after receiving the results via the Web site than before. It seems

that applying the necessary security measures in redesigning the hospital Web site reduced patients' anxiety over the confidentiality. Siedner²² revealed that patients are concerned about the confidentiality of information sent through text messages and they prefer to use encrypted messages and PIN codes when receiving their results.

Another feature of the Web site was the possibility of reprinting which was given a high priority after receiving the laboratory results. A lack of access to a printer to print paper copies of electronic results was a challenge for patients. This challenge was exacerbated by the fact that some physicians do not have access to the Internet in their offices or some ask patients to bring the paper copies of the results. Hence, few patients asked the hospitals to give them paper copies of the electronic results.

A study by Giardina²¹ showed that some participants keep the printed laboratory results due to lack of access to the portal and its updated version.

In his systematic study entitled "The safety implications of missed test results for hospitalised patients: a systematic review," Callen⁴⁸ suggested that simultaneous use of paper and electronic clinical information systems was associated with errors and duplications, while use of electronic systems itself causes fewer errors.

In the postimplementation phase, participants gave a high priority to receiving some information such as physician's name and the date of receiving laboratory results. The presence of such information helps patients to associate test results to corresponding visits. Some of the participants found this method appropriate for their future visits and requested presentation of information about the interpretation of the results on the Web site. Providing more information helps patients understand and interpret their health information much better.^{43,49} In the present study, most participants were willing to receive their normal and abnormal results via the Web site. Results of other studies conducted on this area confirmed the findings of this study.^{24,34,50} In a study by Giardina,²¹ participants were willing to receive their abnormal results through the portal.

The small number of participants was one of the limitations of this study. Since this research was conducted in a relatively small city where the destinations are close to each other, some people had no difficulty receiving their results in person. Moreover, although some people were willing to receive their laboratory results online, they preferred to receive the results in person due to some reasons such as low computer literacy or no access to the printer.

To our knowledge, one of the strengths of this study was that no research has been conducted on the use of SMS reminders and on sending test results to the hospital Web site. Moreover, since this study was carried out at a public hospital, different types of laboratory results were delivered to the patients through the Web site. Hence, data were gathered based on the viewpoints of different patients with different diseases.

Results of this research revealed that participants believed using Web sites and SMS reminders about uploading results on this Web site was very useful, as well; they were satisfied with this method. Compared to other communication technologies such as

email and SMS, this method has some advantages such as adding a variety of capabilities such as the interpretation of laboratory results and the possibility of online consultation; participants in this study during their subsequent visits to the hospital wanted to get their results from the Web site and asked for more capabilities, especially interpretation of results on the Web site. Therefore, it is recommended to add such capabilities on the Web site to increase patients' satisfaction. One of the barriers that prevented patients from participating in this research was their low computer literacy. Thus, some measures such as running necessary educational courses should be taken to increase patient's computer literacy and ability to access their medical files. Another limitation of this study is that to communicate the laboratory test results with patients, we only considered the patients' viewpoints. To integrate the laboratory test results into the hospital Web site in a valid way, not only perspective from patients but also from healthcare providers could be helpful.

The results of this study can be used by the developers of laboratory information systems in order to design systems that facilitate electronic communication of the test results with patients through accessible media. By considering the patients' viewpoints and priorities, they can develop systems with functionalities that are more acceptable. Patients can play an important role in helping system developers to develop systems that meet the patients' needs. Further research should attempt to examine whether the developed communication method for delivering the laboratory results, based on patients' viewpoint, is usable in long term.

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RESEARCH ETHICS

This study was approved by research ethics committee of Kerman University of medical sciences (IR.KMU.REC.1394.379).

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