

The Effect of an E-learning Course of Patient Safety on Nursing Staff's Knowledge: Pre-Post Examination

(An Applied Research on Makkah Hospitals and Primary Healthcare Centers during Hajj Season 1436^H)

¹Fatin Sabbagh, ²Areej A. Al-Shamasi

Health Services and Hospitals Management Department King Abdul Aziz University, Jeddah, KSA

Abstract: Training healthcare staff, especially nurses, is one of the challenging in healthcare during hajj season. According to healthcare statistics on 1434^H, nurses represented the largest group working in hajj season with more than 31%. Limitation of space and time synchronized with such huge number of nurses' staff who always need to be trained on maintaining patient safety specially when dealing with guests of Allah, are emerging the need for e-learning strategy. The objectives of this research were to assess nurses' knowledge in patient safety before and after viewing patient safety e-learning course and to evaluate the effectiveness of the e-learning course on nurses' patient safety knowledge during hajj season, 1436^H in Makkah and Al- Mashaer Al- Moqadasah hospitals and primary healthcare centres. The research methodology followed was experimental design, specifically one group pre-post examination experimental method by using an e-learning course of patient safety. Purposive sampling technique was applied to formulate the sample of this research. The e-learning course has been introduced online for one month. After that period of time, the results were as follows: knowledge level of the research sample on pre-exam was fairly high. They got significantly higher scores on post-exam than those on pre-exam. The result [T = 5.5, P = 0.000], and value of η^2 (0.16) demonstrated the significant differences between the level of nurses' knowledge on patient safety before and after viewing the e-learning course. The researcher reached to a conclusion that nurses were fairly knowledgeable about patient safety on pre-exam. When they enrolled on a patient safety e-learning course, they displayed a great improvement in their knowledge regarding patient safety. This proved that e-learning can be a precious and effective strategy for hospitals and primary healthcare centers when training a large number of nursing staff on any updating in patient safety.

Keywords: E-Learning- Training- Nursing- Patient Safety- JCI- Hajj –Saudi Arabia- Makkah.

I. INTRODUCTION

E-learning (Electronic Learning) is one of the most critical changes in the way of conducting training. The implementation of such strategy in healthcare sector in Saudi Arabia aims to overcome the distance and time limitations that facing almost all educators there. Moreover, It improves effective learning and teaching which may affect economic and social development positively [1]. Among the efforts that healthcare professionals offer to decrease patient harm is training. Training has an important role in developing knowledge, therefore, is needed to promote patient safety in hospitals.

Patient safety which is defined as protecting patients of harm considers the core of health care quality [2]. All staff within healthcare systems, especially nurses, supposed to be trained on patient safety [3]. That is nurses mostly accompany patients all of time in hospitals. In this research, nurses' staff who participated in hajj program 1436^H in Makkah governmental hospitals and Al- Mashaer plus to primary healthcare centres was invited to enrol in patient safety e-learning course- which is the core of the current research.

Identifying the effectiveness of an e-learning course can be obtained through assessing the learning process. One of the fundamental functions of assessment is getting an idea of the level that learners will become in. E-learning effectiveness means that knowledge adds value to learners, and can be used in place of work. For this research, a patient safety e-learning course will be designed based on six international patient safety goals that nurses should follow according to JCI standards.

1. Rationale:

Training healthcare staff, especially nurses, is one of the challenging in healthcare during hajj season. Nurses represented the largest group working in Hajj season with more than 31% [4]. Limitation of space and time synchronized with such huge number of nurses' staff who always need to be trained on maintaining patient safety specially when dealing with guests of Allah, are emerging the need for e-learning strategy. Such strategy will deliver concentrated information on international patient safety goals. Moreover, it will grant the participants freedom in viewing the course whenever and wherever they find it suitable for them. Such advantages of e-learning enforce the researcher to apply an experimental method in order to investigate the influence of e-learning course of patient safety on nurses' knowledge, using pre- post examinations.

2. Previous Studies:

Many studies had spotlighted the effect of e-learning strategy and importance of patient safety. A study conducted by Van de Steeg et al. entitled "The effect of an e-learning course on nursing staff's knowledge of delirium: a before-and-after study", aimed to assess the extent level of the effectiveness of an e-learning course on nurses' knowledge about delirium. It concluded with demonstrating that nurses' knowledge has been enhanced after viewing the e-learning course. [5]. Van de Steeg et al. concluded another study with title "Can an e-learning course improve nursing care for older people at risk of delirium: a stepped wedge cluster randomized trial", with a recommendation that hospitals can adopt e-learning tool in training nurses' staff on any updates regarding delirium as it demonstrated its effectiveness [6]. Al-Anazi conducted a study to discover the effectiveness of multimedia in e-learning environment on developing creativity and motivation at king Saud university. The results showed some means of differences in motivation and creativity between experimental groups [7].

Regarding patient safety, many other studies concluded with the need of finding a treatment or intervention to improve safety of patients in hospitals and healthcare centers [8], [9], [10].

All of the studies mentioned above demonstrated the importance of patient safety issue for nurses' staff. Also, they demonstrated the effectiveness of adopting e-learning as an educational tool in educating health care practitioners.

The present research differs of the previous ones in its introducing of International patient safety goals. These goals are issued by JCI which all hospitals and primary healthcare centers in Makkah are trying to get its accreditation. The big population and time selected to conduct the e-learning course distinguishes this research of the others, as hajj season characterizes with huge number of staff synchronized with limitation of space and time.

II. METHODOLOGY

1. Study Design:

Due to the nature of this research, the researcher adopted experimental method specifically- one group pre-post examination- to assess the effectiveness of independent variable on the dependable one. The researcher used an e-learning course on patient safety as an independent variable and measured its impact on nurses' patient safety knowledge (as a dependent variable). That was done by applying a pre-exam on the respondents before viewing the e-learning course, then applying a post-exam on the same respondents to know the impact on their knowledge level after the course. After that, the researcher compared the scores of both exams to respond the research questions.

2. Research Population and Sampling:

In order to determine the original community of the research, the researcher used the new statistics for the academic year 1436H \ 2015 issued by Hajj Administration at General Directorate of Health Affairs, Makkah Region. It determined that the current population of the research was (3982) nurses. Table (1) shows the nursing numbers and their distribution.

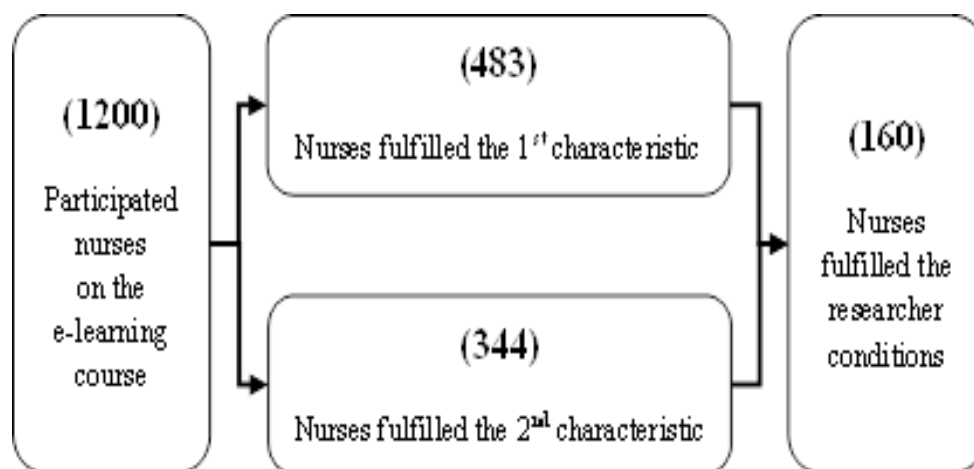
Table 1: Population of nursing staff

<i>Locations</i>		<i>No. of Nurses</i>
Hospitals	Al- Noor Specialist hospital	797
	Hera General Hospital	235
and	King Faisal Hospital	224
	King Abdul Aziz Hospital	435
Primary Healthcare Centers	Maternity and Children Hospital	356
	Ajyad Emergency Hospital	94
at Makkah	Ibn Sina Hospital	63
	Primary Healthcare centers in Makkah	458
Total		2662
Hospitals	Arafat General Hospital	93
	Al-Rahmah General Hospital	68
and	Namerah Hospital	49
	East of Arafat Hospital	141
Primary Healthcare centers	Mina Emergency Hospital	111
	Mina Al- Wadi Hospital	185
at Al- Mashaer Al-Moqadasah	Mina Al-Jesir Hospital	93
	Mina Al- Sharea Al-Jadeed Hospital	98
	Primary Healthcare centers in Al- Mashaer	482
Total		1320
Total number of nurses		3982

For sampling, the researcher used “homogeneous sampling” that is one type of purposive sampling technique. The acceptable sample size with this technique is (30) subjects in each group for experimental studies [11], [12]. The sample group whom has been involved in this research was all nurses' staff who viewed the patient safety e-learning course and had the following characteristics:

- 1- Were working in the assigned hospitals and primary healthcare centers- mentioned in the research limitations- during hajj season.
- 2- Performed both pre and post examinations.

Any of participants who did not fulfil those two conditions, their results did not include in the research. Fig. (1) will simplify sampling numbers.

**Figure 1: Flow chart to illustrate the response rate of nursing staff**

3. E-Learning Environment:

This section presents detailed information about patient safety e-learning course into three sections, as follows:

3.1. Procedures:

The e-learning course on patient safety aimed to assess nurses' knowledge of patient safety. An experimental method has been used to achieve this objective. All nursing staff working on the assigned place of works- that were set by the researcher- were invited to view the e-learning course which introduced on 1st of Dul-Qedah, 1436^H and ended at the last of the same month. None of the nursing staff in the assigned places have started before the other.

3.2. Developing Patient Safety E-learning Course:

The main idea of the e-learning course was (6) international patient safety goals that issued by JCI. Each goal was explained within four angles: the importance of the goal, how to implement the goal, when to implement the goal, and important notes about the goal. To keep the interaction of the learners, some kinds of multimedia was used; such as sound, illustrated images and hypertext.

3.3. Pre – Post Exam Assessment:

The questions in the exams were developed originally by McZoom Ltd in New Zealand, which is a specialized company in training field. It develops test questions for organizations in various fields.

The total number of questions in the exam was (13). They have been divided into six main fields according to the number of international patient safety goals. Two questions were assessing the knowledge of each goal, plus to one worked as general question. The table (2) shows the distribution of the questions and index (2) involved the exam form.

Table 2: Distribution of exam's questions

<i>Fields</i>	<i>Question No.</i>
General Question	1
The 1st goal: Identifying patients correctly	2-3
The 2nd goal: Improving effective communication	4-5
The 3rd goal: Improving the safety of high-alert medications	6-7
The 4th goal: Ensuring of correct-site, correct-procedure, correct-patient surgery	8-9
The 5th goal: Reducing the risk of health care-associated infections	10-11
The 6th goal: Reducing the risk of patient harm resulting from falls	12-13

The types of questions were multiple choice, multiple responses, and true/false questions. Clear instructions were developed on the first page of the exam. Passing the post-exam successfully by getting score 60% or more, participated nurses were eligible to get a certified certificate.

3.4. Data Collection Tools “Instruments”:

Data of this research was collected by using the following instruments:

- **Pre-exam assessment:** This has been held electronically before viewing the e-course. The objective was to assess participants' knowledge that they had before joining the course.

This exam has been designed by using (Google Form) service. Sharing link and inserting it at the beginning of e-learning course, the learner performed the exam easily. The results were appeared in an excel sheet with the demographic factors of every participant.

- **Post-exam assessment:** This also has been held electronically but directly after viewing the e-course. The objective was to assess participants' knowledge gained after joining the course. Since the software which was used in designing patient safety e-learning course (Articulate Storyline) allows having only one test result, post-exam has been designed with this software.

Using (Articulate Online) service to collect the data of post-exam, many reports could be issued. The information that was generated of these reports included participants' demographics, time taken to view the course, number of slides viewed, exam status “passed/failed”, and the score viewers obtained. Moreover, every participant was free to print its report. It is worth mentioning that (Articulate) is an excellent American product spread on about (151) countries all over the world.

4. Statistical Analysis:

The research data was analyzed using SPSS version 20.0. The following statistical methods were used:

- 1- Frequency distribution percentages and ratios, which aimed to identify the distribution of the research sample after the research application by demographic factors.
- 2- Pearson correlation coefficient to calculate the internal consistency of the sincerity of the research.
- 3- Coder Richardson formula 20 (KR-20) to calculate the reliability of research assessment tool.
- 4- Chi-square Test for Independence to calculate the interaction between participants' demographics and pre-exam and post-exam scores.
- 5- Mean and Standard deviations for all paragraphs of the exams in order to identify the extent of dispersion of the answers of sample subjects.
- 6- Two-tailed dependent t-test (paired t-test) to determine the statistically significant differences between the average grades of the pre-exam and the average grades of the post-exam.
- 7- ETA square (η^2) to measure the impact of the independent variable on the dependent variable.

5. Results and Discussion:

To show the effectiveness of an e-learning course of patient safety on nurses' knowledge during hajj season, the four questions of this research had been statistically analysed.

1. Is the e-learning course on patient safety an effective strategy during hajj season?

The effectiveness of the e-learning course has been proved by the significantly higher scores the participants got in all questions on post-exam than those on pre-exam. Mean difference score between both exams was (+1). By calculating Chi2 test, participants' demographics also proved the effectiveness of the e-learning course.

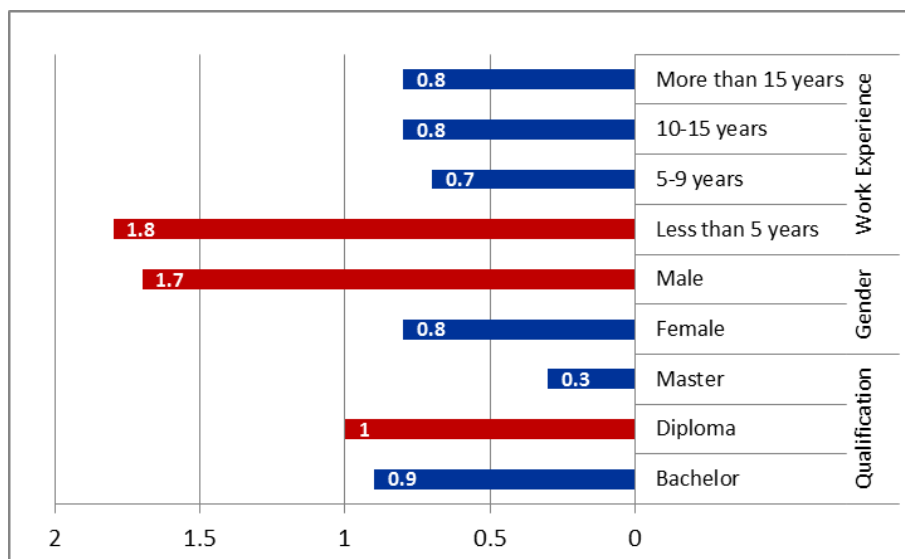
Although participants scores improved in post-exam, and participants with Diploma degree got the highest score with mean (+1), qualification factor was not an effective factor on nurses' knowledge for both exams. This result may assure the importance of patient safety issue for all nurses' grades, and there is no difference between them in maintaining the safety of patients.

Gender of participants was an effective factor on their knowledge in pre-exam and post-exam. Both nurses' male and female had an improvement in their knowledge regarding patient safety. Surprisingly, male scores were higher than female with mean score (+1.7).

Work experience was not an effective factor on participants' knowledge in pre-exam, but it had an influence on improving the participants' knowledge in post-exam. As members of nursing staff who have work experience less than five years were more beneficiaries of the e-learning course, this might be a good indicator that this course can be a good contributing tool in educating the new nursing employees on patient safety. Table (3) and graph (1) show the results.

Table 3: Comparison between pre-post-exam scores and Chi2value

Demographic Factors		Frequency	Pre-exam		Chi2	P value	Post-exam		Chi2	P value	M2-M1
			M1	SD1			M2	SD2			
Qualification	Bachelor	101	8.9	2.3	28.5	0.160	9.8	1.7	30.2	0.065	+0.9
	Diploma	56	8.1	2.8			9.1	2.4			+1
	Master	3	8.0	1.0			8.3	2.4			+3
Gender	Female	120	9.1	2.4	36.4	0.00	9.9	1.7	23.9	0.008	+8
	Male	40	6.9	2.0			8.6	2.2			+1.7
Work Experience	Less than 5 years	33	7.9	2.0	41.1	0.157	9.7	1.9	46.6	0.02	+1.8
	5-9 years	63	9.2	2.4			9.9	1.8			+0.7
	10-15 years	51	8.4	2.8			9.3	2.0			+0.8
	More than 15 years	13	8.0	1.8			8.8	2.2			+0.8
Overall		160	8.6	2.5			9.6	1.9			+1



Graph 1: Mean difference between pre and post exams scores

2. What is the level of nurses' knowledge about patient safety before viewing the e-learning course?

At pre-exam, nurses faced some difficulty with the two questions of the patient safety goal number 4 (Ensure Correct-Patient, Correct-Procedure, and Correct-Site Surgery). The mean score for this goal was (0.9) and percent (45%).

In general, nursing staff's knowledge level on the pre-exam was fairly high with a mean exam score of (8.8) and percent (67.7%). The results appear in table (4).

This score may represent the increase attention that Ministry of Health in Kingdom of Saudi Arabia pays to patient safety issue, plus to the great efforts in educating nurses on patient safety topic.

Table 4: Mean, standard deviation and percentage for pre-exam

Knowledge Fields	Questions Items	Mean	SD	Percent	Level
General question	1	0.77	0.42	77%	Good
Identifying patients correctly	2	1.4	0.66	70%	Good
Improving effective communication	2	1.4	0.63	70%	Good
Improving the safety of high-alert medications	2	1.4	0.74	70%	Good
Ensuring of correct-site, correct-procedure, correct-patient surgery	2	0.9	0.73	45%	Poor
Reducing the risk of health care-associated infections	2	1.5	0.65	75%	Good
Reducing the risk of patient harm resulting from falls	2	1.5	0.65	75%	Good
Total	13	8.8	0.82	67.7%	Fair

3. Are there any differences between the level of nurses' knowledge of patient safety before and after viewing the e-learning course?

The statistics on table (5) revealed that there were significant differences in mean of all exam questions with high scores in post-exam. The result [$T = 5.5$, $P = 0.000$], and value of η^2 (0.16) demonstrated the significant differences between the level of nurses' knowledge on patient safety before and after viewing the e-learning course and the high effect of the e-learning course.

Table 5: Two-tailed dependent t-test and ETA-squared test

Knowledge Fields	Mean	SD	T	Df	P value	η^2	Effect size
General question	0.04	0.56	0.98	159	0.329	0.006	No effect
Identifying patients correctly	0.21	0.54	4.8	159	0.000	0.14	High
Improving effective communication.	0.40	0.66	7.7	159	0.000	0.27	Very High

Improving the safety of high-alert medications	0.02	0.55	0.43	159	0.67	0.001	No effect
Ensuring of correct-site, correct-procedure, correct-patient surgery	0.12	0.75	2.01	159	0.046	0.02	Low
Reducing the risk of health care-associated infections	0.16	0.65	3.15	159	0.002	0.05	Low
Reducing the risk of patient harm resulting from falls.	0.17	0.63	3.50	159	0.001	0.07	Medium
Total	0.94	2.1	5.5	159	0.000	0.16	High

4. What are the aspects of nurses' knowledge of patient safety that have been improved after viewing the e-learning course?

We can answer this question through the results of the previous table, where the effect size has been calculated. Eta-squared explored the effect size of the independent variable over the nurses' knowledge of patient safety. It is clear that the more aspects of nurses' knowledge of patient safety that have been improved after viewing the e-learning course were:

- Improving effective communication,
- then, Identifying patients correctly,
- then, Reducing the risk of patient harm resulting from falls,
- then, Reducing the risk of health care-associated infections,
- then, Ensuring of correct-site, correct-procedure, correct-patient surgery.

On the other hand, the results in the previous table indicated that viewing the e-learning course had no effect on the following fields:

- Improving the safety of high-alert medications,
- Then, General question.

Table (6) simplifies knowing the aspects' order of the nurses' knowledge of patient safety that have been improved after viewing the e-learning course.

Table 6: Chronological order of improved knowledge fields

<i>Knowledge Fields</i>	η^2	<i>Order</i>
General question	0.006	6
Identifying patients correctly	0.14	2
Improving effective communication	0.27	1
Improving the safety of high-alert medications	0.001	7
Ensuring of correct-site, correct-procedure, correct-patient surgery	0.02	5
Reducing the risk of health care-associated infections	0.05	4
Reducing the risk of patient harm resulting from falls	0.07	3

So, e-learning has demonstrated the positive effect on nursing staff's knowledge of patient safety during hajj season that characterizes with huge number of nurses synchronized with limitation of space and time. The high participation rate and big sample size in this research showed that e-learning is a desired strategy by nurses' staff to help in improving their knowledge. This, together with MOH continues instructions on adhering to patient safety goals, supports developing more e-learning courses for nurses' staff working in Makkah and Al-Mashaer Al- Moqadasah. Moreover, when nursing staff be more educated in patient safety issue, they would be better able to provide a good quality care for patients and maintaining right techniques when dealing with them. Consequently, this will potentially decrease the rate of medical errors and their negative results.

III. CONCLUSION

“The Effect of an E-learning Course of Patient Safety on Nursing Staff’s Knowledge: Pre-Post Examination” is the title of this research that has been conducted by the researcher to determine whether nurses in Makkah and Al- Mashaer Al-Moqadasah governmental hospitals and primary healthcare centers are able to develop their knowledge in patient safety after viewing an e-learning course during hajj season 1436^H. In order to do that, the researcher adopted experimental method specifically- one group pre-post examination experimental method- to assess the effectiveness of independent variable on the dependable one. Purposive sampling technique was chosen to formulate the research sample. To generate the results of pre and post exams, the researcher used different statistical analysis which showed that nurses level on pre-exam was fairly high. After viewing the e-learning course, their performance on post-exam was improved more of pre-exam.

1. *Strength of the research:*

The present research has acquired its strength of some matters that are listed below:

- Time and place that researcher selected to conduct this research on, in addition to selecting one of the most critical topics in health care field.
- The adherence to JCI guidelines that MOH concentrates on while designing the scientific content of the e-learning course.
- The big sample size of participated nurse in this research (160) that exceeds so much the lowest recommended sample number- (30) subjects.
- The way of constructing this research allows other researchers to repeat the experiment and get the results.

2. *Ethical Consideration:*

- This research has been submitted to ethical committee to get an approval upon conducting this research.
- Obtaining an official approval letter from Directorate of Health Affairs, Makkah to conduct this research in Makkah governmental hospitals and Al-Mashaer plus to primary healthcare centers during hajj season1436^H.
- The information gathered in this research has been used for the purposes of this research only.

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