

# Effectiveness of E-learning Compared to Classroom Learning in the Diagnostic Approach to Bioterrorism and Chemical Terrorism for Emergency Physicians

Alavi-Moghaddam M, MD<sup>1</sup>; Molavi Gh, MD<sup>2</sup>; Shahrami A, MD<sup>1</sup>; Hatamabadi H, MD<sup>1</sup>; Shojaei M, MD<sup>1</sup>; Heidari K, PhD<sup>1\*</sup>

<sup>1</sup> Department of Emergency Medicine, Shahid Beheshti University of Medical Sciences, Tehran, Iran

<sup>2</sup> Shahid Beheshti University of Medical Sciences

## Abstract

**Background and purpose:** Emergency physicians play an important role in the immediate diagnosis of bioterrorism activities. The present study was conducted with the purpose of comparing the effectiveness of e-learning and classroom learning in approach to bioterrorism and chemical terrorism for emergency physicians.

**Methods:** This was a semi-empirical study, which was conducted via testing knowledge before and after the educational intervention in the field of bioterrorism and chemical terrorism on the emergency physicians in Tehran. The external validity of the questionnaire was confirmed by two academic experts in order to determine the ability to detect bioterrorist and chemical terrorist diseases. In this study, education was done in both virtual and classroom forms. The education regarded 6 bioterrorist diseases in group A (anthrax, plague, viral hemorrhagic fever, tularemia, smallpox), and 5 chemical terrorist diseases (nerve gas, mustard, lewisite, phosgene, chlorine).

**Results:** 160 doctors participated in this study. 96 people (60%) were men and 64 people (40%) were women. The average age of the participants was  $36.2 \pm 5.5$  years. In e-learning method, the pre-test scores average was (30.6%), while the post-test scores average was (81.6%) ( $p=0.001$ ). In classroom learning method, the pre-test scores average was (41.9%), while the post-test scores average was (72.9%), which the pre-test and post-test scores average differences in both cases are significant ( $p<0.001$ ). In e-learning method, the difference was (51%), and in the classroom method it was (31%), which these two represent a 20% difference between methods. From statistical point of view, this difference indicates that the e-learning method being more effective ( $p=0.02$ ).

**Conclusions:** Based on the study results, it seems that in comparison to the classroom learning, e-learning method is more effective in helping emergency physicians to diagnose bioterrorism or chemical terrorism factors.

**Keywords:** E-LEARNING, CLASSROOM LEARNING, CHEMICAL TERRORISM, BIOTERRORISM, EMERGENCY PHYSICIANS

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## Introduction

Terrorism is the use or threat to use violence or power against people or property to intimidate, force and levy in support of political or social objectives (1). Bioterrorism

is the use of biological agents in order to create public panic. Biological agents can be bacteria, fungi, virus, or bio-toxins (2). Chemical Terrorism is the use of chemical agents as the terrorism factor, including nerve agents, blood agents, blister agents, and suffocating agents (3). The use of chemical and biological agents as war weapons is not only related to the recent years. During history, various nations have used the bodies

**Corresponding author:** Mostafa Alavi-Moghaddam, Associate Professor of Emergency Medicine, Shahid Beheshti University of Medical Sciences.  
Academic email: mosalavi@sbmu.ac.ir

of those who have died of the plague against their enemies (4). During the wars of the European countries and the Native Americans, smallpox was used as a biological weapon and caused mass death among the Indians (5). In 1915, during World War I, Chlorine gas was used as a war weapon (6). Phosgene gas was used during World War I and II; and also in 1938 by the Japanese against the Chinese forces (7). During the 8-year war with Iraq, various chemical weapons were used by Iraq against our nation, including nerve agents and mustard gas (8). Tokyo subway Sarin gas attack left 640 victims in 1995. In this attack, 5,000 people came to emergency rooms for medical examination. This terrorist attack had killed 12 people (9). Terrorist attacks in 2001 in United States by Anthrax agent, left 5 people dead, and caused bioterrorism became the center of attention in medical societies (10).

Bioterrorism and chemical terrorism are one of the educational topics in emergency medicine, which due to the rarity of such accidents; they are currently either omitted or only memorized for answering the exam questions, or to improve the specialized board.

One of the problems in the traditional education methods is that learners are not capable of using scientific information and doing their professional tasks in real conditions. Learners often forget what they have learned via traditional methods. Therefore, education experts have presented another learning system which is problem-based, which has been used by most universities in different countries in recent years. The origin of problem-based learning is in medical sciences, where most of its initial growth has occurred. Problem-based learning is a method of designing and presenting the course which uses real-life problems as a stimulus for the learner to learn (11).

Biological agents have several features that make them attractive for the terrorist use. One of the advantages of these agents is the disastrous consequences despite the use of

small amounts of this material. These agents are odorless and could not be easily identified, could not be detected by metal detectors, could be easily transported to big cities by planes, and that they could be easily prepared by a skilled microbiologist (12).

Biological agents have the potential to create public panic, even if very few people infected by it, all the city or even the country would be terrified if they know they are exposed to the deadly terror agent. Emergency team, in addition to patients, should be prepared to answer worried people and should be worried about dangerous diseases. Therefore a biological warfare is a potential threat, and it requires the emergency physicians' preparation in order to detect and deploy proper approach (13).

The current state of the world indicates the necessity of preparing to counter bioterrorism or chemical terrorism. If a bioterrorist attack happens, in a short time a large number of people will be affected and the emergency rooms are first places being swarmed by a large number of infected or even just worried people. Skills of the emergency physicians are essential to control the crisis. The first critical step, detect the agent and take measure to treat patients and prevent the spread of the disease. Over a short period of time, a large number of people may be required to be vaccinated or use prophylactic antibiotics. Thus any suspicious disease must be reported to health authorities.

Since emergency physicians are first line of defense against bioterrorist or chemical terrorist agents in terms of diagnosis, it is very important that they can detect the bioterrorist agents.

Previous studies, each have analyzed the results of virtual and classroom learning over the approach to detect bioterrorism or chemical terrorism. According to our reviews, no study has been found about the difference between two approaches toward bioterrorism and chemical terrorism. According to the general advantages of e-learning in medical science and the need to pay attention to it, this study aimed to compare the effectiveness of

virtual and classroom learning over the approach toward detecting bioterrorism or chemical terrorism.

## Methods

This was a quasi-experimental study, which aimed to compare the effectiveness of virtual and classroom learning of emergency physicians over the approaches to detecting bioterrorism or chemical terrorism.

Target population was emergency physicians in Tehran. Samples were collected through easy sampling method. This relevant knowledge of participants was measured in a pretest and posttest. To assess the diagnostic competency of physician in area of bioterrorism and chemical terrorism, a multiple choice test was. Data collection tool was a questionnaire that was designed in two parts. The first part was questions about demographic data (age, gender, work experience in emergency), the second part included 13 questions about the diagnostic approaches to 6 bioterrorism syndromes (cutaneous and respiratory anthrax, plague, viral hemorrhagic fever, tularemia, smallpox, botulism), and 10 questions about the diagnosis of 5 chemical terrorism syndromes (nerve gas, Mustard, Chlorine, Phosgene, Lewisite). The questionnaire was confirmed by two independent academic experts, who had no information about the program and the target group. To increase the participation of doctors, CME score of 4.5 were given to the participants. Participants were divided into two groups. Both groups were physicians working in emergency departments in Tehran, and did not have any significant difference based on education and previous knowledge (pre-test) regarding detection of bioterrorism. The first group was trained virtually and the second group was trained in classroom. The classroom learning was held in Imam Hussein Hospital, and Shahid Beheshti University of Medical Sciences (SBMU) website was used for e-learning. The lesson plan was the same for both virtual and classroom learning, and used materials were Emergency Medicine

educational resources, internet images, and bioterrorist events. The goal of this training was that participants learn to detect so-called agents. In this program it was not taught how to treat and deal with bioterrorist events. The presentation of both methods was a slide show, along with teacher comments. In both groups, the purpose was to teach how to detect bioterrorist events through real or synthetic problem scenarios (Problem-Based Learning). In e-learning method, a 75-minute educational video was produced and uploaded on continuing education website of SBMU. In classroom learning method, a similar class was presented for 2 hours with the presence of volunteer doctors. Evaluation was conducted via multiple choice tests. Tests questions were about the detection of bioterrorist attacks agents. Question bank included 100 problem-based picture questions which in each of the pre-test and post-test stages, 23 random questions were chosen. Participants must fill the pre-test questionnaire before viewing the program, after that viewed the program, and finally they had a chance to get ready within two months to respond the post-test questions. In classroom learning, 23 problem-based picture questions were designed for each of the pre-test and post-test stages and a similar training program was held in classroom. Participants filled two questionnaires in one session. Scores of the test were analyzed by two independent statisticians.

In this study, the Cronbach's alpha of test was used in order to determine the validity and reliability of the questionnaire, which an alpha number of 0.856 was achieved. Also the normality of the data was analyzed using the K-S Test. In order to describe the data, prevalence, mean, standard deviation, range and confidence intervals of 95% were used. In order to compare the pre-test and post-test results a confidence intervals of 95% and the Paired t-test were used. The Independent Sample t-test was used in order to analyze the differences between groups. In this study, the pre-test and post-test data of each person was

compared to himself. A ( $p<0.05$ ) was considered statistically significant. Data analysis was done using the SPSS 17 software.

**Table 1.** Baseline Characteristics of Study Subjects

Baseline Characteristics	Virtual (N=100) N (%)	Classroom (N=60) N (%)
Gender		
Male	58 (58)	38 (63)
Female	42 (42)	22(37)
Age (years)		
Mean (SD)	35.3±5.4	37.2±5.7
Median (range)	35 (30-48)	33 (28-49)
Work Experience in the Emergency		
Mean	3.8±5.4	4.5±4.5
Median	3.7	2.3

**Table 2.** Changes in mean scores based on training methods

	Virtual Mean±SD	Classroom Mean±SD	Diff (95% CI)	p value
<b>Bioterrorism</b>				
Cutaneous anthrax	13 ± 29	5 ± 18	8 (-1 to 17)	0.06
Pulmonary anthrax	50 ± 39	27 ± 37	23 (8 to 38)	0.002
Tularemia	59 ± 40	32 ± 38	27 (12 to 42)	0.01
Plague	73 ± 39	59 ± 37	14 (0 to 28)	0.06
Hemorrhagic fever	25 ± 44	5 ± 22	20 (8 to 32)	0.01
Botulism	35 ± 44	13 ± 33	22 (7 to 37)	0.004
Smallpox	39 ± 42	19 ± 32	20 (7 to 33)	0.004
<b>Chemoterrorism</b>				
Chlorine	55 ± 42	33 ± 47	22 (3 to 41)	0.025
Phosgen	72 ± 37	55 ± 45	17 (1 to 33)	0.04
Mustard	66 ± 37	42 ± 35	24 (10 to 38)	0.001
Lewisit	65 ± 40	42 ± 42	23 (8 to 38)	0.004
Nerveagent	54 ± 43	37 ± 36	17 (2 to 32)	0.019
Total	51 ± 40	31 ± 5	20 (6 to 34)	0.02

## Results

160 doctors participated in this study. 96 (60%) of them were men and 64 (40%) were women. The average age was  $36.2\pm 5.5$  years. Table 1 indicates the demographic characteristics of the participants.

In e-learning method, the pre-test average score was 30.6% and it was 41.9% in classroom learning method that did not indicate a significant difference between them ( $p=0.06$ ).

In e-learning method, the pre-test average score was 30.6%, while the post-test average score was 81.6% which indicates the effectiveness of the training ( $p=0.001$ ).

In classroom learning method, the pre-test average score was 41.9%, while the post-test average score was 72.9% which indicates the effectiveness of the training ( $p=0.001$ ).

The pre-test and post-test scores difference in e-learning method was 51%, while it was 31% for classroom learning method; this shows a 20% difference between two methods. This difference statistically shows that e-learning method is better ( $p=0.02$ ).

Table 2 shows the average changes of the pre-test and post-test scores classified by bioterrorist and chemical terrorist agents, standard deviation, difference between two groups, and a confidence coefficient of 95%.

## Discussion

Terrorism is a global threat and emergency physicians are the first-line contacts in these events. Awareness is essential to diagnose and delay in diagnosis has dire consequences. The present study showed that e-learning method is much more effective than classroom learning method in educating doctors in detection of bioterrorism and chemical terrorism.

A study by Trandrop et al. titled as Online Continuing Education on Bioterrorism was published in 2005. In this study and in order to teach how to detect bioterrorism, computers were embedded in emergency room which showed pictures about bioterrorism on their screensavers that changed every 5 seconds, and included a link to a website about bioterrorism training group (A). The emergency physicians, nurses, infectious diseases, radiology and pathology specialists could take part in the bioterrorism education program by clicking on the mentioned link. The questionnaires showed that the combination of the website with the screensavers had improved the emergency physicians' diagnosis of 5 bioterrorist diseases of group (A). According to this study, the website and screensavers could be used in order to improve the awareness of doctors and nurses in the emergency room used for biological bioterrorism and web-based learning is an effective way to teach bioterrorism (14).

A study by Casebeer et al. titled as The Analysis of Continuing Online Education on Bioterrorism was published in 2006. In this retrospective study, a group of doctors who attended online continuing education program about bioterrorism were compared to another group who had taken part in another online continuing program which was not the same

as the first website. An online questionnaire was designed to assess the ability to detect the disease associated with group (A) bioterrorism. According to the statistical calculations, it was shown that 100 samples, 50 samples for each group, can detect 10-15% differences between the two groups with a confidence rate of 90%. According to results, the group who participated in continuing education programs compared to the control group had better scores in detection of bioterrorism. According to this study, online bioterrorism education courses have an important role in preparing emergency physicians in diagnosis of rare bioterrorism diseases (15).

A study was published in 2005 (Arch Inter Med) by Sarah et al. titled as The Ability of Emergency Physicians in The Diagnosis of Bioterrorism Group (A). In this multi-center study, 631 emergency physicians were examined online for their ability to diagnose group (A) bioterrorist diseases including anthrax, botulism, smallpox, and plague. Their diagnosis ability test scores were 51% for anthrax, 16% for plaque, 50% for botulism, and 51% for smallpox. Understanding treatment for bioterrorism test scores were 15% for anthrax, 10% for plaque, 60% for botulism, and 17% for smallpox. After training, their ability to diagnose and treat bioterrorism diseases reached 79% (16).

In a study titled as Effectiveness of Three Medline Educational Methods for Medical Students, which had been published by the Isfahan Center for the Study of Medical Education in Iranian Journal of Medical Sciences, the online and classroom learning methods had been compared. This study did not report statistical differences between the two methods, but our study showed that in medical education, online learning is more effective than the other (17).

Unlike classroom learning, in e-learning, students are able to choose their education time based on his/her physical and mental fitness, and also based on learning, he/she can watch the training materials frequently.

## Conclusions

Considering the importance and effectiveness of the e-learning, it is recommended to pay attention to e-learning in emergency medicine education program, especially in bioterrorism and chemical terrorism fields.

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