

E-learning for grass-roots emergency public health personnel: Preliminary lessons from a national program in China

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Summary

In China, grass-roots emergency public health personnel have relatively limited emergency response capabilities and they are constantly required to update their professional knowledge and skills due to recurring and new public health emergencies. However, professional training, a principal solution to this problem, is inadequate because of limitations in manpower and financial resources at grass-roots public health agencies. In order to provide a cost-effective and easily expandable way for grass-roots personnel to acquire knowledge and skills, the National Health Planning Commission of China developed an emergency response information platform and provided trial access to this platform in Anhui and Heilongjiang provinces in China. E-learning was one of the modules of the platform and this paper has focused on an e-learning pilot program. Results indicated that e-learning had satisfactorily improved the knowledge and ability of grass-roots emergency public health personnel, and the program provided an opportunity to gain experience in e-course design and implementing e-learning. Issues such as the lack of personalized e-courses and the difficulty of evaluating the effectiveness of e-learning are topics for further study.

Keywords: Online training, public health workers, e-course, pilot study

1. Introduction

Grass-roots emergency public health personnel (GEPHP) are responsible for dealing with a large number of public health emergencies in the early stages, and their capabilities directly affect the occurrence of emergencies and their impact on society (1). Therefore, the knowledge and capabilities of GEPHP should be enhanced. In China, there are nearly 200,000 GEPHP, and these GEPHP face difficulties: *i*) GEPHPs have relatively limited emergency response capabilities; and *ii*) recurring and new public health emergencies require GEPHP to constantly update their professional knowledge and skills (2). Professional training is a principal solution to these problems (3,4). After

outbreaks of severe acute respiratory syndrome (SARS), the Chinese Government invested heavily in the creation of a public health system, with a particular emphasis on manpower. However, manpower and financial limitations in basic public health agencies often preclude GEPHP from receiving sufficient training. At present, GEPHP receive formal training only 1-2 times a year, less than one week in total. In addition, the heavy workload at grass-roots agencies also increases the difficulty of organizing training programs. In general, learning tends to be ineffective. Learning is primarily affected by limited learning opportunities and a lack of systematic and long-term programs. As a result, GEPHP have been unable to update their professional knowledge in a timely manner and they have limited emergency response capabilities, and this situation has changed little. The inadequate training of GEPHP in China remains a challenge (5). Self-training and self-improvement through e-learning is an ideal way to overcome this challenge (6-8).

Compared to traditional face-to-face forms of centralized learning, e-learning has the advantages of no time and site restrictions, low costs, and ease of

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organization, and e-learning has become an important form of vocational education in various fields in developed countries (9-12). In China, however, e-learning is primarily focused on degree education (e.g. correspondence education) at present. Wide-scale use of e-learning in vocational education seldom occurs in the field of public health. Existing methods of instruction rely primarily on traditional face-to-face learning. Simple video presentations and e-courses delivered via the Internet are occasionally used. To the extent known, a systematic and formal e-learning program for public health personnel has yet to be reported in China.

In order to provide a cost-effective and easily scalable way for GEPHP to acquire knowledge and skills, the National Health and Family Planning Commission of China developed an emergency response information platform (ERIP) in 2011. The Commission used Microsoft Visual Studio 2008 as the develop platform, SQL Server 2008 as the data management tool, and java as the programming language. The ERIP was completed and opened to the public in April 2013. Trial access to the ERIP was provided in Anhui and Heilongjiang provinces. The ERIP consists of five modules: information searches, e-learning, outbreak maps, incident news, and training. This paper describes the e-learning component of ERIP e-learning (hereafter refer to as the ERIP-EL).

2. Development of the ERIP-EL

The ERIP-EL was intended for GEPHP, and a key aspect of the creation of the ERIP-EL was the development of suitable e-courses for GEPHP. E-courses featured in the ERIP-EL are based on two principles: the knowledge and skills that GEPHP lack and the knowledge and skills that GEPHP should acquire. Here, public health emergencies handled by GEPHP were classified into eight types. An investigation of requirements and Delphi consultation were both used to identify the key knowledge and skills for GEPHP.

An *investigation of requirements* was used to identify the knowledge and skills that GEPHP lacked. This investigation was accomplished via an on-site survey methodology including quantitative and qualitative research. Random cluster sampling was used to select more than 2,000 respondents from databases at the Centers for Disease Control (CDC), medical facilities, and health administration agencies at the city or county/district level in Heilongjiang and Anhui provinces in 2012. A questionnaire was individually administered to each respondent. In addition, individual in-depth interviews were conducted. Frontline emergency health personnel who were responsible for responding to and managing emergencies were interviewed in group interviews.

Delphi Consultation was used to identify the knowledge and skills that GEPHP should acquire. In March, May, and June 2012, consultation was

conducted three times. Twenty-four experts were invited from 13 sub-provincial institutions, including health administration departments, grass-roots health institutions, public health departments in universities, and other related fields. Experts were asked to score various incidents (out of 100) based on three aspects: the frequency of the emergency, incident hazards, and prompt improvement of emergency response capabilities. Required skills for GEPHP were determined based on the final score according to the technique for order performance by similarity to the ideal solution (TOPSIS).

Fifty-nine categories of core skills and knowledge were comprehensively identified, as shown in Table 1, and corresponding e-courses were developed by experts in different fields who were part of the ERIP-EL program team. Each course was presented to learners in the form of a digital slide show, a digital document, a video lecture, a game, a role-playing drill, or a toolkit depending on its characteristics (13-15).

Refinement of the ERIP-EL The adjustability of e-courses for GEPHP is crucial, so frontline health emergency experts and specialists in public health emergencies were invited to view and amend the e-course content to make sure that the content was factually correct and also that it met the practical needs of GEPHP. The forms in which e-courses were presented was also evaluated and constantly modified to presentation the course most effectively.

The ERIP-EL uses a browser/server architecture, and learners can access the ERIP-EL by typing a URL in their Internet browser. After entry of their personal information and registration, learners can access the platform to start learning.

In 2014, trial access to the ERIP-EL was provided to grass-roots public health agencies (GPHA) in Anhui and Heilongjiang provinces in China for one year, and a total of 441 GEPHP participated in and completed the e-learning program. Of these learners, 210 (45.4%) were male. The one-year e-learning period was divided into two six-month stages: unspecified study and specified study. In the first stage, participants were allowed to choose e-courses to study depending on their interests and actual work requirements. In the second stage, participants were required to complete prescribed e-courses including elective and compulsory courses. After the e-learning period, a t-test was used to compare the average pre-learning score and post-learning score for GEPHP, and self-evaluation was used to assess the improvement of capabilities.

3. Trial access to the ERIP-EL

Use of the ERIP-EL. During the e-learning period, most learners (56.9%) logged on to the platform 1-2 times a week, and their favorite form of e-course presentation was a digital slide show (55.6%) (Table 2). Learning

Table 1. List of core skills and knowledge that GEPHP should acquire

Category	Key skills and knowledge
Infectious disease	1) On-site investigation (P,V,T,G) 2) Team creation (P,W) 3) Response to report (P,V,W,D) 4) Communication of risk (P,V,T) 5) Health education (P,V,W) 6) Personal protection (W,V) 7) Incident report (P,V,W) 8) Monitoring (P,V) 9) Sampling (P,W) 10) Incident verification (P,V,W) 11) Incident detection (P,V)
Food poisoning	1) Response to report (P,V,W,D) 2) Incident verification (P,V,W) 3) On-site investigation (P,V,T) 4) Sampling (P,W) 5) Team creation (P,W) 6) Communication of risk (P,V,T) 7) On-site medical aid (P,V) 8) Technical preparations (P)
Occupational poisoning	1) Incident report (P,V,W) 2) Incident verification (P,V,W) 3) Response to report (P,V,W,D) 4) Communication of risk (P,V,T) 5) Technical preparations (P,V)
Environmental pollution	1) Communication of risk (P,V,T) 2) Public health education on-site (P,V) 3) On-site medical aid (P,V,D) 4) Personal protection (W,V)
Mass psychogenic reaction	1) Communication of risk (P,V,T) 2) Incident verification (P,V,W) 3) Response to report (P,V,W,D) 4) Incident report (P,V,W)
Nuclear contamination and radiation	1) Personal protection (W,V) 2) Incident report (P,V,W) 3) Response to report (P,V,W,D) 4) Training (P,V)5) On-site medical aid (P,V)
Large incident support	1) On-site medical aid (P,V,D) 2) Response to report (P,V,W,D) 3) Emergency planning (T) 4) Supplies (V) 5) Training (P,V) 6) Technical preparations (P)
Medical aid	1) On-site medical aid (P,V,D) 2) Team creation (P,W) 3) Supplies (V) 4) Response to report (P,V,W,D) 5) Training (P,V) 6) Drills (P) 7) Incident report (P,V,W) 8) Communication of risk (P,V,T)

D, role-playing drill; G, game; P, digital slide show; T, toolkit; V, video (lecture or cartoon); W, digital document. GEPHP: grass-roots emergency public health personnel.

times were mainly in the afternoon (77%).

Attitudes towards the ERIP-EL. After a year of e-learning, most participants (74.8%) had a positive attitude towards the platform and they felt that

Table 2. E-learning times for GEPHP and their favorite forms of e-courses

Variable	n (%)
Frequency of use	
Less than 1 time a week	141 (32)
1-2 times a week	250 (56.9)
3-4 times a week	44 (10)
More than 5 times a week	5 (1.1)
Favorite form of e-course	
Digital slide show	245 (55.6)
Digital document	112 (25.4)
Video	171 (38.8)
Toolkit	90 (20.4)
Game	25 (5.7)

GEPHP: Grass-roots emergency public health personnel.

e-learning was "useful/very useful" for their work, with only 0.9% responding that it was "bad/very bad." Compared to pre-learning scores, participants' average scores improved substantially after e-learning (58.5 vs. 85.5, $p < 0.01$), as did their pass rate (26.2% vs. 92.3%, $p < 0.01$). Participants rated the improvement in their capabilities as "general improvement," indicating improvement to a certain extent (16,17). One reason for this finding may be because this e-learning pilot program lasted 1 year and the effects of the program have yet to appear. Therefore, long-term and systematic learning are more helpful to GEPHP.

After the formal e-learning period, 67.98% of the participants were logging on to the ERIP-EL to actively learn depending on their needs, and participants who had 1-2 years of work experience more actively participated in e-learning than those with less than 1 year of work experience or those with more than 2 years of work experience. Of the participants, 73.52% regarded the ERIP-EL as a tool to solve daily work-related problems. The most influential factor for participants was whether the e-course met their needs (Table 3).

4. Lessons and issues

This attempt to provide training in the field of public health emergency response provided an opportunity to gain experience and identified several problems with the development of e-learning that will help with the future development of related programs.

Development of the ERIP-EL. The survey indicated that a digital slide show was the most popular form of e-learning, while game learning was favored little. This may be because GEPHP were unfamiliar with this new form of e-learning. Therefore, attention should be paid to informing potential learners about the development of new forms of e-courses. An interface should also be developed to ascertain the needs of learners after they complete an e-course so that e-courses can be continually improved based on that feedback.

Results also suggested that communication among

Table 3. Factors influencing e-learning by GEPHP

Influence factors	n of answers (%)	
	Yes	No
Do hardware conditions influence e-learning?	326 (73.9)	115 (26.1)
Do basic computer skills influence e-learning?	298 (67.6)	143 (32.4)
Do e-courses meet the needs of GEPHP?	382 (86.6)	59 (13.4)
Do administrators support e-learning?	289 (65.6)	152 (34.4)
Is there sufficient motivation to participate in e-learning?	277 (62.9)	164 (37.2)

GEPHP: grass-roots emergency public health personnel.

GEPHP is essential for self-learning. Therefore, a module should be incorporated in the ERIP-EL so that learners can indicate which courses they selected, search posted test scores on e-courses, exchange learning experiences, and even communicate instantly with other learners. This environment will help to establish a friendly atmosphere among learners, increase their enthusiasm, and make learning more effective.

At present, the ERIP-EL is just a platform for presenting e-courses that learners can choose to study. Results of the pilot study indicated that some GEPHP had difficulty determining the right e-courses to study, and this was especially true for new personnel. E-courses need to be tailored to learners. Tailoring e-courses can be based on two principles: *i*) compulsory and elective courses depending on the learner's position and *ii*) courses that learners perform poorly on according to their test scores. These steps will save learners' time in searching for courses and also make learning more effective by identifying learners' weaknesses.

Motivation to participate in e-learning and evaluation of its effectiveness. Self-learning depending on needs is one of the advantages of e-learning. In the provinces studied, however, a moderate proportion (67.98%) of GEPHP logged on to the ERIP-EL and took part in e-learning. Reasons for this may include a heavy work load, family duties, and limited self-control. In the absence of monitoring, the ERIP-EL may fail to teach effectively by relying solely on self-learning. External requirements and incentives, such as credits, certificates, or benefits, may be necessary for successful e-learning. Moreover, obtaining support from administrators of grass-roots agencies is essential when starting an e-learning program since they can create a conducive e-learning environment for GEPHP.

Evaluation of the effectiveness of learning can be divided into multiple types depending on the purpose. Because of the inherent characteristics of e-learning, evaluating its effectiveness is a challenge for the evaluator (18). According to Kirkpatrick's training evaluation model, evaluation can be clarified into four levels: reaction, learning, behavior, and results (19). The developed program had difficulty determining whether learners had actually enhanced their ability to cope with

public health emergencies during the e-learning period. Thus, the effectiveness of e-learning was assessed using a test of knowledge test and self-evaluation of ability, which are the first two levels of Kirkpatrick's model. Plans are to assess the effectiveness of e-learning at the levels of behavior and results in a long-term study in the future.

Sustainability of the ERIP-EL. Operation of the ERIP-EL requires personnel and funding. The result of a national project, ERIP-EL is free for registrants to access. Once the project ends and funding and operation & maintenance personnel are no longer provided, a pressing problem will be how to sustain the ERIP-EL. One suggestion is that departments, such as public health departments or emergency response organizations, could take over management of the ERIP-EL.

Prospects. If administrative measures conducive to e-learning are implemented, e-learning can effectively improve the capabilities and problems-solving ability of GEPHP. Given the limited training resources of GPHA, e-learning can be a feasible and alternative form of education.

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