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## Original Research

# Improving emergency preparedness capability of rural public health personnel in China

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## SUMMARY

**Objectives:** Since the outbreaks of severe acute respiratory syndrome and avian influenza, improving the emergency preparedness capability of rural public health personnel has become a new priority in building the infrastructure needed to address public health emergencies. The Chinese Government has carried out a series of emergency preparedness education and training programmes to improve the emergency preparedness capability of rural public health personnel nationwide. The purpose of this study was to evaluate and develop a participatory emergency preparedness training programme for rural public health personnel.

**Study design:** The research emphasizes the major components of instructional design, including assessing, designing, delivering and evaluating training. The approach is an integrated system with results from one phase influencing the next, so that a series of steps are followed when developing, implementing and evaluating emergency preparedness training.

**Methods:** The 226 participants were rural public health personnel from 84 different rural centres for disease control and prevention in China. The programme was evaluated by anonymous questionnaires and semi-structured interviews held prior to training, immediately post-training and 12-months after training (follow-up).

**Results:** The emergency preparedness training resulted in positive shifts in knowledge and skills for rural public health personnel. At follow-up, the knowledge and skill scores of participants declined slightly compared with the post-test levels ( $P > 0.05$ ). However, there was a significant increase compared with the pre-test levels ( $P < 0.01$ ). Moreover, more than 90% of participants reported that this training provided a valuable learning experience and reinforced the importance of emergency preparedness.

**Conclusions:** The emergency preparedness training programme was effective and feasible in improving the performance of rural public health personnel on emergency response. Further studies are needed to test the efficacy of the training approach for competency improvement.

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## Introduction

The severe acute respiratory syndrome (SARS) outbreak of 2003 and the avian influenza attack of 2004 led to a new urgency in China to prepare public health personnel for responding to public health emergencies. However, these threats have only compounded the need for an effective public health infrastructure, of which competent rural public health personnel is a necessity.<sup>1</sup> The Chinese Government and local health departments have carried out a series of emergency education and training programmes to improve the capability of rural public health personnel in emergency response.<sup>2</sup> However, it remains unclear whether these training programmes are feasible and effective in improving the capability of emergency preparedness, or if changes are needed to correct the current programmes.

Previous studies showed that the emergency preparedness capability of rural public health personnel was insufficient in China, such as unfamiliarity with emergency response protocols and management procedures, and inability to collect and analyse the relevant data during the SARS outbreak.<sup>3,4</sup> In order to change the current situation and improve the emergency preparedness capability of rural public health personnel, an emergency preparedness training programme for rural public health personnel was developed and supported by the Ministry of Health (MOH) and the World Health Organization (WHO). The study was carried out by Tongji Medical College Emergency Institute from 2006 to 2007 in China. The training was completed in 2006, and a follow-up survey was conducted 12-months later.

## Research design

The emergency preparedness training programme was conducted according to an integrated instructional design system model (Fig. 1), which emphasizes the major components of instructional design, including assessing, designing, delivering and evaluating training.<sup>5,6</sup> The approach is an integrated system with results from one phase influencing the next, so that a series of steps are followed when developing, implementing and evaluating emergency preparedness training. This process begins with literature review and needs assessment, enabling the development of instructional objectives specifying what is to be achieved in the training, which, in turn, provides input for designing, delivering and evaluating the effectiveness of the training programme.<sup>6–8</sup> As Fig. 1 shows, the approach is a closed-loop system. Information resulting from evaluation of training effectiveness is used to determine whether or not the training met its previously defined aims and objectives. This information provides feedback to modify future training system features by reassessing training needs, revising course objectives or altering the delivery methods. The emergency training approach is evolving continually, with results from previous programmes being used to continuously improve future training programmes.<sup>7</sup> Thus, the purpose of this research was to describe the training process, evaluate the effectiveness of the training, and develop a participatory emergency training approach for rural public health personnel.

## Methods and subjects

### Aims and objectives

The aims and objectives of training were designed carefully in consultation with educational and training experts who have profound knowledge of the public health emergency response plan and the training programme. The overall goals of the programme were to: (1) improve the response capabilities of rural health personnel and increase response knowledge and skills; and (2) develop and deliver a participatory training approach on responding to public health emergencies. The objectives of the training were subjected to continuous monitoring and evaluation during the training period.

### Participants and trainers

The 237 participants were rural public health personnel from 84 centres for disease control and prevention (CDC) in Hubei (2–3 persons per unit). There were 79 trainees from the class of October, 86 from the class of November, and 72 from the class of December. Eleven trainees did not complete their training for unrelated reasons, and are not included in the evaluation ( $n = 226$ ). Trainers came from MOH, WHO, Chinese CDC, Wuhan University and Huazhong University of Science and Technology. The selection of trainers was based on expertise in the field of public health emergency response, especially related training programmes and involvement in continuous consultations on health service programmes, both educational and promotional.

### Training methods

As in the authors' previous study, various training methods were used including case studies, workshops, tutorials, seminars, group discussions, role-playing, drills and field-work.<sup>9</sup> Formal lecturing was the least used method. The training centre was equipped with modern audiovisual aids designed for training purposes. The training logistics and general services, such as transportation and accommodation, were provided free of charge to the participants.

### Training content

The training used the US CDC's emergency preparedness core competencies for all public health workers as a framework.<sup>10–12</sup> In brief, the training contents consisted of: (1) the definition of a public health emergency; (2) the public health personnel's role during emergencies; (3) the responsibilities of local, provincial and government agencies during emergencies; (4) the role of the CDC during an emergency; (5) the CDC emergency response chain of command; (6) emergency communication strategies and use of special equipment; (7) emergency response protocols; and (8) management procedures, including the management of necessary supplies and equipment. These topics met the learning objectives displayed in Table 1. The training contents and objectives were subjected to continuous monitoring and evaluation throughout the training period.

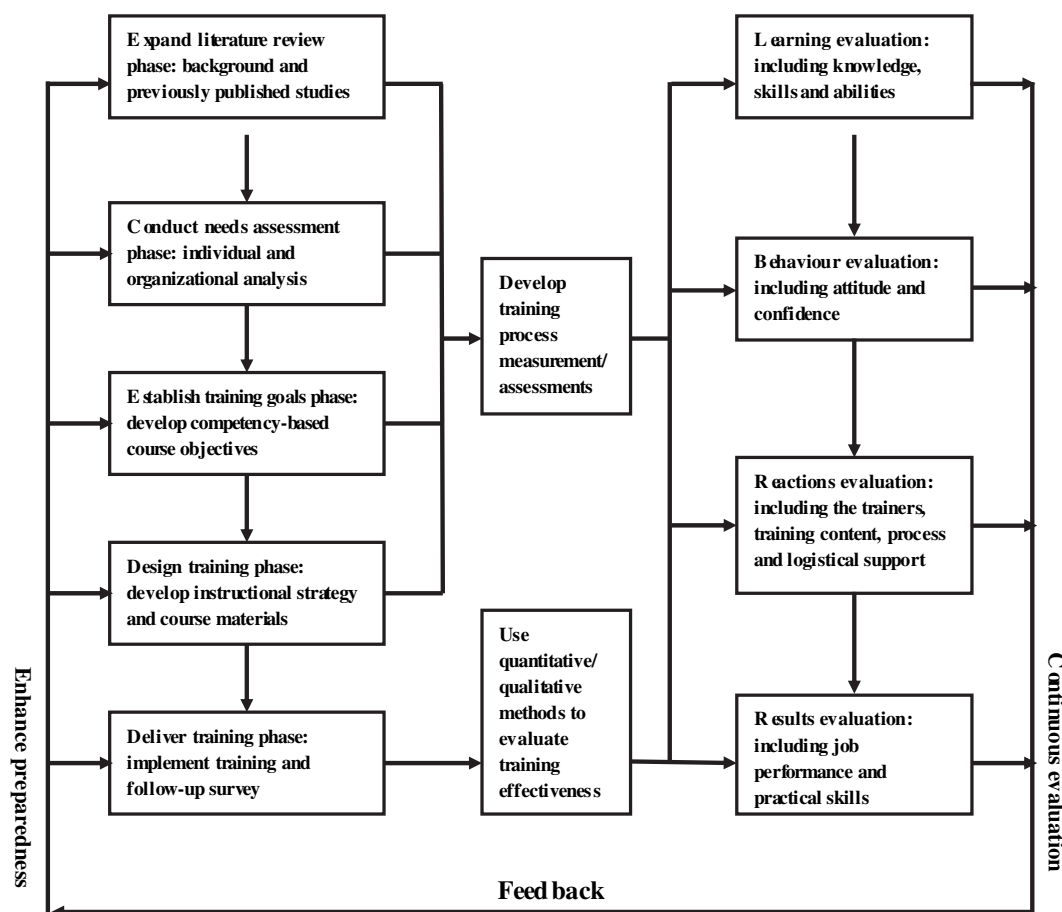


Figure 1 – The public health personnel training approach.

### Evaluation design

The purpose of evaluating any programme is to identify its strengths and weaknesses so that modifications can be made. This was especially true for this programme which was designed to be innovative, relevant, flexible and not just a 'one size fits all'. The evaluation instrument included an anonymous questionnaire and semi-structured interviews.

Thirty questions assessed the participants' knowledge of the public health emergency competencies according to the 'Core Public Health Worker Competencies for Emergency Preparedness and Response'<sup>9</sup> and 'Ten Essential Public Health Services',<sup>13</sup> which consisted of basic public health science knowledge, emergency management knowledge and emergency analytic/assessment skills (10 questions for each). For these questions, if the correct answer was provided, the participant received one point; incorrect answers received no points. Additionally, respondents were asked eight self-assessment questions so that the frequency of their use of each of the competencies could be measured.<sup>14</sup> Responses were rated on a five-point scale (1 = 'very low', 2 = 'low', 3 = 'middle', 4 = 'high', 5 = 'very high').<sup>15</sup> Participants completed the pre-training measurement (pre-test, baseline) on the first day of training. The post-training measurement (post-test) was conducted at the end of the last day of training. For follow-up measurement (follow-up test), the participants were mailed

a survey with a self-addressed return envelope 12-months after completion of the programme.

Training methods and resources were subjected to continuous monitoring and evaluation by semi-structured interview.<sup>16,17</sup> The inclusion of the trainees in the evaluation process was extremely helpful in updating and modifying the programme for the betterment and satisfaction of all participants. The items addressed in the semi-structured interviews were described in the authors' previous research.<sup>9</sup> The semi-structured interview pro forma was distributed at the end of each session to be completed anonymously by each participant; it was analysed immediately and the results shown to the trainer who had conducted the session. If any defects were revealed, the necessary changes were made immediately. Evaluation of workshops and fieldwork was carried out in a similar fashion. Feedback of the results from the evaluation was given to the participants.

### Data analysis

Most data were reported as scores. Frequency and confidence scores were derived for each domain by participants' responses to all the frequency questions and all the self-efficacy questions separately. Repeated-measures analysis of variance was used to test differences between pre-test, post-test and follow-up test.

**Table 1 – Learning objectives: emergency preparedness training programme for rural public health personnel.**

No	Core competencies for public health personnel
1.	<b>Describe</b> the public health role in emergency response in a range of emergencies that might arise (e.g. this department provides surveillance, investigation and public information in disease outbreaks and collaborates with other agencies in biological, environmental and weather emergencies)
2.	<b>Recognize</b> unusual events that might indicate an emergency and <b>describe</b> appropriate action (e.g. communicate clearly within the chain of command)
3.	<b>Demonstrate</b> correct use of all communication equipment used for emergency communication (telephone, fax, radio, etc.)
4.	<b>Identify</b> limits to own knowledge/skill/authority and <b>identify</b> key system resources for referring matters that exceed these limits
5.	<b>Describe</b> his/her functional role(s) in emergency response and <b>demonstrate</b> his/her role(s) in regular drills
6.	<b>Identify</b> and <b>locate</b> the agency's emergency response plan (or the pertinent portion of the plan)
7.	<b>Explain</b> the interaction of central and local agencies and <b>describe</b> communication role(s) in emergency response (media, within agency, general public and personal)
8.	<b>Describe</b> the chain of command and management system ('incident command system' or 'similar protocol') for emergency response in the jurisdiction
9.	<b>Apply</b> creative problem-solving and flexible thinking to unusual challenges within his/her functional responsibilities and <b>evaluate</b> effectiveness of all actions taken

The data of semi-structured interviews were categorized independently by three authors using the triangulation method, and the individual results of the analysis were compared and discussed until consensus was reached. All results were expressed as mean  $\pm$  standard deviation. Data were analysed using one-way analysis of variance with Statistical Package for the Social Sciences Version 12.0 (SPSS Inc., Chicago, IL, USA) for Windows. A P-value of  $< 0.05$  was used as the significance level.

## Results

### Demographic characteristics

In total, 237 public health personnel participated in the emergency preparedness programmes, and 226 participants completed the entire training programme (response rate = 95.36%). Men constituted more than half of the study cohort ( $n = 185$ , 81.86%). Sixty-one respondents (26.99%) had a Bachelor's degree or a Master's degree. Most respondents ( $n = 172$ , 76.11%) had more than 5 years of experience as a public health worker. The majority of respondents ( $n = 158$ , 69.91%) had participated in inter-related training, but the previous training had occurred 12–24 months prior to the study. The results of the reliability assessment showed that test-retest reliability and the internal consistency of questionnaires was accredited to some extent (test-retest reliability of pre-training = 0.81, Cronbach's alpha  $> 0.60$ , respectively). The results of related analysis indicated that the construct validity of the questionnaires was of high quality (related coefficient fluctuated between 0.36 and 0.77,  $P < 0.05$ ).<sup>18,19</sup> The intra-observer agreement was good for qualitative data (mean Kappa = 0.72; 95% confidence interval 0.45–0.95), which showed moderate or substantial agreement.

### Knowledge levels

The research results revealed that the knowledge scores regarding public health emergency preparedness were relatively low at baseline ( $18.50 \pm 3.23$ ). Immediately after the training, a dramatic increase was observed in the mean knowledge score ( $22.78 \pm 1.14$ ). A slight decrease was found

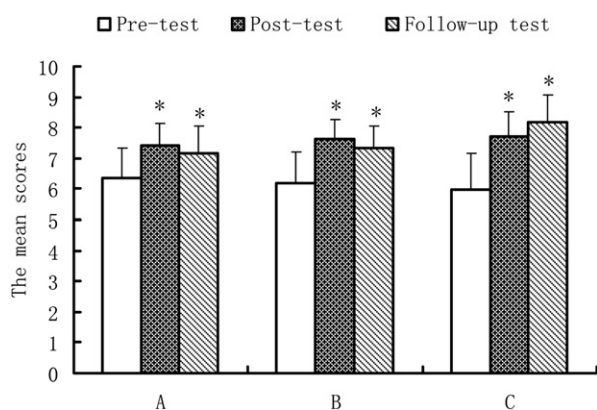
between the mean 12-month follow-up score ( $22.69 \pm 2.49$ ) and the mean post-test score ( $P > 0.05$ ), but the mean score at 12-month follow-up was considerably higher than the mean pre-test score ( $P < 0.01$ ). In addition, basic public health science and culture knowledge scores declined slightly at 12-month follow-up compared with the post-test scores ( $P > 0.05$ ), but emergency analytic/assessment knowledge scores were dramatically increased at 12-month follow-up compared with the post-test scores ( $P < 0.05$ ) (Fig. 2).

### Skill levels

Descriptive statistics on the self-assessment of skills at pre-training, post-training and follow-up are presented in Table 2. As mentioned earlier, the responses ranged from high (5) to low (1). The results showed that participants reported a significant improvement in their skill level across all eight competency areas examined immediately after training compared with pre-training ( $P < 0.01$ ). The greatest improvements were reported in the participants' basic public health sciences skills (improvement in mean score from 2.69 to 4.69,  $P < 0.01$ ) and analytic/assessment skills (improvement in mean score from 2.54 to 3.91,  $P < 0.01$ ). Twelve months later, there was a slight decline in some competency areas compared with the post-test results ( $P > 0.05$ ), but the mean scores were still much higher in all eight competency areas compared with the pre-test scores ( $P < 0.01$ ).

### Programme evaluation

The results of the semi-structured interviews showed that participants perceived that the training methods, content, presentations, instructors' responsiveness and value, and the sessions overall were of high quality. Most participants ( $n = 207$ , 91.59%) thought that the training methods were excellent or very good, meaning that the training contents were clearly and easily understood, and 95.58% ( $n = 216$ ) of the participants were satisfied with the trainers' performance. Analysis of results showed that more than 88.50% of participants ( $n = 200$ ) reported that the training approach was scientific and feasible. Additionally, most participants



**Figure 2 – Mean knowledge scores of participants for pre-training, post-training and follow-up tests (n = 226). Data are shown as mean ± standard deviation. All comparisons were performed by one-way analysis of variance. A, basic public health science knowledge; B, emergency management knowledge; C, emergency analytic/assessment skills.\*P < 0.05 vs pre-test.**

(n = 222, 98.23%) were very satisfied with the venue, training logistics and services.

## Discussion

Public health personnel emergency preparedness training was a required component of the CDC-funded emergency response activities for central and local health departments.<sup>20</sup> As a recently introduced training approach, the emergency preparedness training will require further evaluation to develop a cost-benefit profile of its impact as a training tool (developing preparedness knowledge and skills among participants) versus its approach (primarily time, content, process and personnel).

A primary goal of the research was to improve the response capability of rural public health personnel, and increase response knowledge and skills.<sup>8</sup> Results from the study showed that the training programme not only made positive shifts in both knowledge of and performance in public health emergency response, but also changed attitudes and behavioural intentions of rural public health personnel. The results

of the follow-up survey showed that the knowledge and capability of participants were still increased 12-months after the training, with positive attitudes and behavioural intentions to change compared with pre-training.

The second goal was to launch a scientific training approach regarding public health emergency preparedness. Previous research showed that the various training methods were recommended by educators because different participants learned by different training methods, and ‘methods of active training’ could usually give better results in the training process.<sup>21–25</sup> The results of this research suggested that the emergency preparedness training not only resulted in encouraging effectiveness, but also created a scientific and effective training approach. The training process, content, trainers, logistics and services were recognized by participants and trainers. For example, more than 90% of participants thought that the training methods were excellent or very good, especially the case studies and role-playing exercises. All results demonstrated that the emergency preparedness training programme satisfactorily met the anticipated aims and objectives, and rural public health personnel could improve their knowledge and performance while changing their attitudes and behavioural intentions. This is similar to results found by Qureshi et al.<sup>12</sup> and Potter et al.<sup>26</sup>

The limitations of this study should be noted. First, the analysis was limited to the personnel that were primarily engaged in disease monitoring and controlling, and laboratory and environmental health work in 84 CDCs. Second, approximately 35 trainees had participated in a follow-up survey of the control and response to avian influenza in 2007, and the follow-up results could be influenced because this most likely increased their emergency preparedness skills. Third, evaluations were based on changes over time without the use of a horizontal comparison group. Finally, the composite variable/evaluation index used may overestimate the effectiveness of training to some extent, because changes in these composite variable/evaluation indexes were affected by many factors, including emergency preparedness training. Thus, it was not possible to fully determine which changes were due to the emergency preparedness training programme and which were due to other factors. However, the fact that demographic and capability factors remained constant throughout the study provided support that the changes presented above were due to the training programme.

**Table 2 – Change in self-assessment of skills by study respondents.**

Self-assessment of skills	Skill level, mean (standard deviation)		
	Pre-test	Post-test	Follow-up test
Analytic/assessment skills	2.54 (0.76)	3.91 (0.65)*	4.46 (0.73)* <sup>Δ</sup>
Policy development/programme planning skills	2.33 (1.06)	3.48 (0.70)*	2.82 (0.82)
Communication skills	3.16 (0.84)	4.13 (0.65)*	4.27 (0.61)*
Cultural competency skills	2.26 (0.76)	3.44 (0.61)*	3.21 (0.79)*
Community dimensions of practice skills	2.69 (0.81)	3.87 (0.73)*	3.79 (0.65)*
Basic public health sciences skills	3.12 (0.93)	4.69 (0.49)*	4.35 (0.54)*
Financial planning and management skills	2.07 (1.03)	3.26 (0.74)*	2.79 (0.92)
Leadership and systems thinking skills	2.71 (0.99)	3.05 (0.69)	2.84 (0.77)

\*P < 0.05 vs pre-test; <sup>Δ</sup> P < 0.05 vs post-test.

## Conclusions

The training programme met the anticipated aims and objectives, namely improving knowledge and developing skills while improving attitudes and behavioural intentions of rural public health personnel regarding emergency preparedness. This suggests that the emergency training strategy was effective and feasible in improving the capability of emergency preparedness.

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## Ethical approval

All protocols were reviewed and approved by Medical Ethics Committee of Tongji Medical College.

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## Competing interests

None declared.

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