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ORIGINAL PAPER

ASSESSING THE EFFECTIVENESS OF TRAINING PROGRAMME ON THE COMPETENCY OF MEDICAL STAFFS IN PUBLIC HEALTH EMERGENCY

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Abstract

Background: The competencies of medical staff in the public health emergency system and evaluated the effects of system-based professional training were investigated. **Material and Methods:** A competency model for individuals in a public health emergency management system was developed, which contained 33 items with 5 domains. A competency-based intervention was performed. A total of 68 participants from 4 health emergency teams in Xinjiang, China were recruited and randomly divided into 2 groups: the intervention (N = 38) and control groups (N = 30). Participants in the intervention group received competency-based training, while those in the control group received no training. All participants responded to the COVID-19 activities. The competencies of medical staff in the 5 domains were then analyzed in the pre-intervention, post-first training, and post-COVID-19 intervention using a self-designed questionnaire. **Results:** Participants' competencies were at the middle level at baseline. After the first training, competencies in the 5 domains significantly improved in the intervention group; in the control group, there was a significant increase in professional quality compared in the pre-training. After the response to COVID-19, the mean scores of competencies in the 5 domains significantly increased in both the intervention and control groups compared with those in the post-first training. Psychological resilience scores were higher in the intervention group than in the control group, whereas no significant differences in competencies were found in other domains. **Conclusions:** Competency-based interventions provided practice and showed a positive effect on improving the competencies of medical staff in public health teams. Med Pr. 2023;74(1):19–26

Key words: competency, system professional training, public health emergency, self-designed questionnaire, medical staffs, training

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INTRODUCTION

Since the early 2000s, frequent public health emergencies have posed significant threat to public health and societal stability worldwide, such as 9/11 terrorist attacks, severe acute respiratory syndrome (SARS), avian influenza, and Ebola outbreaks [1,2]. The development of resilient management systems for these emergencies is a long-term challenge for communities worldwide. The 58th World Health Assembly in 2005 reported that World Health Organization (WHO) members collaborated to confront global public health emergencies [3]. A World Health Report in 2007 also highlighted global public health security in the 2000s [4]. Thus, public health emergencies will become a global health concern in the future.

China has the world's largest population and second-largest economy. China has increasingly elicited key roles in the prevention and control of global public health emergencies [5]. Although China has made efforts to construct a public health emergency management system, some weaknesses and problems have

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been exposed to the SARS outbreak [6], such as an ineffective response system and information communication. The surge capacity is one of the most important capacities for strengthening the Chinese health emergency system [7]. Numerous emergency education and training programs have been conducted; however, the effect of training on improving emergency competencies of medical staff has not been determined.

A competency model is widely used as a tool to describe the competencies of participants in specific domains to evaluate or improve their competencies following education and/or training [8]. The advantages of competency model development for improving the required skills and knowledge of individuals have been emphasized [9]. In 2007, a public health emergency preparedness (PHEP) competency model was developed by the European Centre for Disease Prevention and Control (ECDC) for European Union countries, which described 102 competencies, 100 knowledge, and 158 skills required for professionals in response to public health emergencies and proposed to be beneficial for PHEP training [10]. A revised 2018 quad council coalition (QCC) competency for public health nursing practice was built through a biphasic Delphi technique, which shows the potential for improving the capacity of public health nursing [11]. In China, competency model-based training for medical staff during public health emergencies is rare.

Therefore, in this study, a competency model for medical workers was developed based on which the author investigated and intervened in the competencies of public health emergency teams using a systematic training program in Xinjiang, China. This study was designed to evaluate the effect of interventions on the competencies of health emergency teams and provide guidance on future training programs.

MATERIAL AND METHODS

Competency model development

A competency model was developed using a multistage process. The first step was to draft the preliminary competencies required for medical staff in public health emergency teams, based on a literature review. After a panel discussion, a list of 58 preliminary competencies was created. Next, 3 types of interviews were conducted to determine the competency elements: expert consultation, critical incident interview, and 3 rounds of focus group interviews. The results of the second-step process were as follows: 43 competencies grouped into 5 domains were determined. To refine the preliminary competency model, a pilot study that recruited 90 medical staff from Centers of Disease Control and Prevention (CDC) health emergency response teams and 60 participants from national disease control and health emergency teams, was conducted based on model-related questionnaires. Eligible responses to questionnaires were defined as more than 50% serious and attentive answers to questions, which were evaluated using a 5-point Likert scale [12]. Structural validity was assessed using the Kaiser–Meyer–Olkin (KMO) and Bartlett tests [13], followed by factor analysis.

Participants and groups in intervention

A total of 68 participants were recruited from 4 health emergency teams in Xinjiang, China, including 19 from the Hotan Health Emergency team, 19 from the Autonomous Region Health Emergency team, 16 from the Kashgar Health Emergency team, and 14 from the Jiashi Health Emergency team. All participants were randomly assigned to 2 groups: the intervention (N = 38) and control groups (N = 30). In the intervention group, there were 10 women and 28 men, of which 31.2% had emergency work experience of 4–6 years, 55.3% were aged 31–40 years. Of the 30 participants in the control group, 73.3% were men, 53.3% were aged 31–40 years, and 31.2% had work experience of 4–6 years.

Participants in the intervention group received training for health emergencies, whereas those in the control group did not participate in any trainings.

Intervention

Between September 2019 and August 2020, 2 separate training sessions were conducted to the participants in the intervention group based on the main content of the competency model. The first training session was conducted in September 2019 prior to a joint response exercise on imported infectious diseases in Kashgar, Xinjiang, and lasted for 5 consecutive days. Three months after the end of the training, an online questionnaire was administered to participants in the intervention and control groups. Shortly after the first intervention, the novel coronavirus disease (COVID-19) outbreak happened, and the second training session was delayed. Considering that the training program was a simulation of public health emergencies, and that the response and management of sudden infectious diseases were the actual and convincing interventions

for health emergencies, the emergency response to the COVID-19 pandemic was set as the second training session. The competencies of medical staff were measured on August 28, 2020 after no new confirmed cases were reported in the Xinjiang Autonomous Region for 14 consecutive days.

Outcome measurements

Before and after the intervention, the effect of training on competencies of medical staff was measured using a questionnaire survey based on the competency model. This questionnaire contained 31 items with 5 dimensions (professional quality, psychological resilience, ability to assess aftermath, emergency knowledge, and emergency skills). The responses to the questionnaires were scored on a 5-point Likert scale, ranging from 1 (strongly agree) to 5 (strongly disagree). Of the 31 questions, Question t18 was reverse-scored.

Statistical analysis

For competency model construction, factor analysis was conducted using AMOS21.0. The effect of intervention on the competencies of medical staff was evaluated between the intervention and control groups at different time points and the intra-intervention group over time. The responses to the questionnaire are shown as mean ± standard deviation (M±SD). The differences between the groups at different time points were analyzed using an independent t-test, and the intra-group difference over time was evaluated using a paired t-test. Statistical analysis was conducted using the SPSS, and statistical significance was set at $p < 0.05$.

RESULTS

Competency model determination

To refine the competency model, a pilot study was conducted with 150 medical workers using a competency-related questionnaire survey. The results suggested that the response rate of the questionnaire was 98.67%, and 138 eligible answers were collected for factor analysis. Factor analysis of scales showed that the KMO value was 0.785, and Bartlett's test revealed that the χ^2 value was 6464.546 ($df = 903$, $p < 0.001$). All these results indicated a high structural validity and that the scale was suitable for further analysis. Exploratory factor analysis indicated that 10 items presented with double loading or low factor loading were deleted, such as "calm personality," "fast reaction," and "lessons learned." A 5-factor model with 33 items was developed (Table 1), in which the lowest factor loading was 0.465 for t27, which was more than 0.4, suggesting that the items in each dimension could explain specific factors. Factors 1–5 were defined as professional quality, psychological resilience,

Table 1. Results of factor analysis in the questionnaire survey of the pilot study among 150 medical workers between September 2019 and August 2020, Xinjiang, China

Question	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
t 1	0.607				
t 3	0.793				
t 4	0.668				
t 5	0.704				
t 7	0.831				
t 8	0.782				
t 9	0.767				
t 10	0.695				
t 13	0.675				
t 26		0.502			
t 31		0.737			
t 32		0.723			
t 33		0.746			
t 34		0.710			
t 35		0.680			
t 36		0.559			
t 37		0.675			
t 14			0.805		
t 15			0.666		
t 16			0.852		
t 17			0.693		
t 18			0.654		
t 19			0.706		
t 24			0.558		
t 27			0.465		
t 20				0.813	
t 21				0.801	
t 22				0.830	
t 23				0.769	
t 28					0.642
t 38					0.455
t 39					0.595
t 40					0.516

Factors 1–5: professional quality, psychological resilience, ability to assess aftermath, emergency knowledge, and emergency skills.

and ability to assess aftermath, emergency knowledge, and emergency skills, respectively.

Baseline information of participants in the intervention

None of the 68 participants received any training within 3 months prior to the intervention. The competencies of the participants were evaluated using a questionnaire survey before and after the intervention. The results showed that the mean scores of competencies in the 5 dimensions of professional quality, psychological resilience, ability to assess aftermath, emergency knowledge, and emergency skills were 2.636±0.575, 3.815±0.470, 2.994±0.262, 2.787±0.484, and 3.596±0.386, respectively. Thus, medical staff competencies were moderate at baseline.

The 68 participants were then randomly divided into the intervention and control groups. The baseline competencies of the participants between the groups were compared using a t-test. The results suggested no significant differences in competency scores between the intervention and control groups (all $p > 0.05$) (Table 2).

Outcomes

To evaluate the effect of training on the competency of medical staff, the authors compared the differences between the intervention and control groups after the implementation of the training. Three months after the first training, the competency scores for participants in the intervention group significantly increased in the 5 dimensions compared to those in the control group (all $p < 0.001$) (Table 2). The effects of the intervention on competency over time were then observed using a paired t-test. Table 3 illustrates that in the intervention group, competency scores after the first training are significantly higher before the training (all $p < 0.001$). In the control group, only the competency score in the professional quality domain significantly increased at the end of 3 months after the first

Table 2. The mean competency scores in intervention and control group at baseline, post the first training, and post-second intervention among 68 medical workers, September 2019–August 2020, Xinjiang, China

Domain	Competency score (M±SD)		t
	intervention group	control group	
At baseline[a]			
professional quality	2.612±0.575	2.667±0.387	–0.388
psychological resilience	3808±0.143	3.824±0.132	–0.132
ability to assess aftermath	2.990±0.153	3.00±0.147	–0.153
emergency knowledge	2.80±0.233	2.772±0.216	0.233
emergency skills	3.632±0.863	3.550±0.820	0.820
Post the first training[a]			
professional quality	3.612±0.714	2.617±0.642	5.964***
psychological resilience	4.304±0.551	3.866±0.632	3.048***
ability to assess aftermath	3.980±0.590	2.991±0.313	8.299***
emergency knowledge	3.816±0.525	2.866±0.568	7.140***
emergency skills	4.296±0.566	3.583±0.541	5.623***
Post-second intervention[b]			
professional quality	4.780±0.358	4.820±0.295	–0.570
psychological resilience	4.479±0.529	4.047±0.539	3.068***
ability to assess aftermath	4.097±0.595	3.915±0.501	1.247
emergency knowledge	4.008±0.525	3.978±0.555	0.216
emergency skills	4.270±0.505	4.380±0.388	–0.939

*** $p < 0.001$.
[a] Intervention group N = 38, control group N = 30.
[b] Intervention group N = 32, control group N = 28.

Table 3. Changes in the competency score at pre-intervention and post-first training, post-first training and post-second intervention and pre-intervention and post-second intervention among 68 medical workers, September 2019–August 2020, Xinjiang, China

Domain	Competency score (M±SD)	t	df
Pre-intervention and post-first training			
intervention group			
professional quality	−0.537±1.015	−4.361***	37
psychological resilience	−2.956±5.550	−4.397***	37
ability to assess aftermath	−0.550±0.710	−6.383***	37
emergency knowledge	−0.610±0.634	−7.929***	37
emergency skills	−0.386±0.497	−6.404***	37
control group			
professional quality	0.050±0.102	2.693*	29
psychological resilience	−4.222±1.55	−1.489	29
ability to assess aftermath	0.008±0.032	1.439	29
emergency knowledge	−0.095±0.132	−3.951	29
emergency skills	0.033±0.157	1.161	29
Post-first training and post-second intervention			
intervention group			
professional quality	−1.031±0.83702	−6.970***	31
psychological resilience	0.1701±0.829	1.161	31
ability to assess aftermath	−0.234±0.742	−1.786	31
emergency knowledge	−0.250±0.822	−1.721	31
emergency skills	−0.234±0.742	−1.786	31
control group			
professional quality	−2.170±0.649	−17.683***	27
psychological resilience	−5.278±7.521	−3.713**	27
ability to assess aftermath	−0.879±0.790	−5.889***	27
emergency knowledge	−1.116±0.824	−7.171***	27
emergency skills	−0.786±0.641	−6.487***	27
Pre-intervention and post-second intervention			
intervention group			
professional quality	−2.063±0.666	−17.519***	31
psychological resilience	−0.329±0.489	−3.806**	31
ability to assess aftermath	−1.242±0.376	−18.709***	31
emergency knowledge	−1.277±0.466	−15.495***	31
emergency skills	−0.711±0.436	−9.227***	31
control group			
professional quality		− 18.695***	27
psychological resilience	−0.565±0.727	−4.110***	27
ability to assess aftermath	−0.871±0.787	−5.857***	27
emergency knowledge	−1.213±0.897	−7.154***	27
emergency skills	−0.821±0.656	−6.629***	27

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

training ($p < 0.05$) (Table 3), which might be attributed to the COVID-19-stimulated patriotism.

An online questionnaire survey was conducted to evaluate the effects of the second training session on medical staff competency. The response rates in the intervention and control groups were 84.2% and 93.3%, respectively. After the second intervention, competency in the psychological resilience domain was higher in the intervention group than in the control group ($p < 0.001$), whereas competencies in other domains showed no significant differences between the intervention and control groups (Table 2).

A paired t-test was conducted to compare the differences in competency after the first and second interventions. As shown in Table 3, competencies in the professional quality domain for participants in the intervention group were significantly enhanced after the second intervention compared with those after the first training ($p < 0.001$). The competency scores of the control group were significantly higher in 5 domains after the second intervention than in the first intervention (all $p < 0.01$). In addition, differences in competency scores in the 5 domains for participants were analyzed before the first training and after the second intervention. Table 3 reveals that participants in the intervention group showed a significant increase in competencies in the 5 domains after interventions (all $p < 0.01$). Similarly, significant differences in competency scores were observed in the control group prior to the first training and after the second intervention (all $p < 0.001$). This indicated that emergency training and practice were helpful for improving the competencies of the medical staff.

DISCUSSION

The frequently occurred public health emergencies have posed threats and challenges to communities, particularly in China [14,15]. The SARS outbreak exposed the weaknesses of the public health emergency management system in China, including the insufficient emergency response of public health staff, which was reflected by the inadequate knowledge in emergency response management and data collection [7,16]. Continuous education and training play key roles for improving skills, enriching knowledge, and improving the ability to deal with tasks [17]. Although a series of health emergency response and management trainings have been conducted to improve health emergency teams in China, a widely approved training program for public health staff is lacking. Thus, this study investigated the competencies of medical staff in the public health system by implementing competency-based training and practice and analyzing the effects of training on competencies based on self-designed questionnaires.

Competency was defined by McClelland (1973) [18] as individual characteristics that predict the performance of employees. The competency-based approach has been recommended as a reference for the development of education, training, and learning; and the advantages of competency model development have been increasingly emphasized in the academic, private business, and public sectors [9]. Calhoun et al. (2008) [19] described a core competency model comprising 119 competencies and 12 domains for academic public health practice [19]. Hewitt et al. developed a 28-item core competency model for education/training in family planning for public health nurses [20]. To improve global health education, Ablah et al. [21] developed a global health competency model with seven domains and 36 competencies required for public health students. In 2017, the ECDC developed a public health emergency preparedness competency model, which served as the basis for training workers in public health emergency preparedness at the country level [10]. However, in China, there is no standardized competency model for individuals working in the public health system.

In this study, the authors developed a 33-item competency model in 5 domains (professional quality, psychological resilience, ability to assess aftermath, emergency knowledge, and emergency skills) for medical workers in the public health system using a multistage process. Competency-based intervention was then conducted on 68 participants from 4 health emergency teams in Xinjiang.

According to the basic information of the participants in the intervention group, men accounted for 74%, which was comparable to the rate of men (73.3%) in the control group. Most of the participators had emergency work experience of 4–6 years with 31.2% in the intervention and control groups. In a previous study evaluating the effect of emergency preparedness training, 75% of the participants were men, and most participants had >5 years of emergency work experience [7], which was consistent with the findings of the present study. These findings suggest that male medical staff have absolute superiority in health emergency teams.

The descriptive statistics on the competency scores of medical staff showed that the competency of medical staff in 5 domains was at the middle-level pre-intervention, ranging 2.636–3.596. Similarly, prior to

an emergency preparedness training program, the competency level of trainees in attitudinal and behavioral intentions at pre-test was at a low level (2–3 pts) [7]. The data showed that after the first training, the mean competency scores in the 5 domains significantly increased in the intervention group compared with that at the pre-intervention, whereas in the control group, only the competency score in professional quality significantly increased. The first training session was conducted during the early days of the COVID-19 pandemic. Although no severe cases were during the COVID-19 pandemic, and participants had not experienced actual emergency management, there was a surge of patriotism about working together to fight COVID-19 across the country. This may be explained by the significant increase in competency in the professional quality of the control group after the first training.

The participants in both the intervention and control groups were treated with emergency response to COVID-19. After the second intervention, only the mean competency score in professional quality significantly increased in the intervention group compared with that after the first training, which may have been caused by the influence of the national environment and determination of the entire population to fight COVID-19. In the control group, the participants responded to the COVID-19 pandemic and showed a significant increase in competency scores in all 5 domains, revealing the importance of practical experience in responding to public health emergencies.

After the second intervention, there was a significant difference in psychological resilience competency compared to the other domains. Those who participated in the training and actual responses to health emergencies exhibited more constructive and psychological resilience. In addition, despite the improvement in competencies in professional quality, ability to assess aftermath, emergency knowledge, and emergency skills, the competency score in psychological resilience was significantly lower in the control group than in the intervention group after the second intervention. Health emergency training simulates actual public health emergencies. The participants in the intervention took part in training and emergency response to COVID-19. The psychological training section in the first intervention may have contributed to the psychological construction of the emergency response of participants in the intervention group. Thus, after the response to the COVID-19 public health emergency, participants in the intervention group showed positive psychological resilience.

CONCLUSIONS

In summary, the competency of the medical staff in the health emergency team was relatively poor. Emergency training and practice were effective for improving the competencies of medical staff in terms of professional quality, psychological resilience, ability to assess aftermath, emergency knowledge, and emergency skills. The professional training program significantly increased competency scores for psychological resilience. Participation in COVID-19 emergency response activities provided practice and increased the perceived relevance of training. This study provides guidance for training programs to improve the competency of medical staff in public health emergency systems.

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