

Perceptions Among Medical Staff in Community Health Centres of Coping Capacity Regarding Infectious Disease Epidemics: A Cross-Sectional Study in Shanghai, China

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Background: With the increasing risk of infectious disease outbreaks around the world, the role of community health centres (CHCs) in the prevention and control of epidemics has become increasingly prominent. This study aimed to examine the capacities, vulnerabilities, and obstacles related to coping with infectious disease epidemics in Chinese CHCs.

Methods: A cross-sectional study was conducted in Shanghai CHCs. Stratified random sampling was used to select 48 CHCs, and 2460 medical staff members responded to questionnaire surveys. ANOVA and multivariate analysis were used to evaluate the current situation and main obstacles regarding CHC medical staff members' perceptions of their capacity to cope with infectious disease epidemics.

Results: The scores for regulation awareness (mean= 3.64, SD= 0.02) and detection/reporting ability (mean= 3.66, SD= 0.02) were lower than the score for the ability to handle an epidemic (mean= 3.79, SD= 0.02). After controlling for covariates, working in a traditional Chinese medicine ($\beta = -0.63, P = 0.002$) or medical technology department ($\beta = -0.60, P = 0.002$), not having participated in emergency exercises ($\beta = -0.78, P < 0.001$), and not having participated in emergency training ($\beta = -0.59, P = 0.01$) were associated with lower scores on all three domains. Those with senior professional titles reported relatively high levels of ability to handle an epidemic ($\beta = 0.21, P = 0.01$). Female workers reported relatively low regulation awareness ($\beta = -0.11, P = 0.02$) and detection/reporting ability ($\beta = -0.11, P = 0.01$).

Conclusion: The three emergency response abilities of CHC medical workers differed based on the medical worker's sex, department, and title, indicating the need for targeted scientific emergency exercises and training for infectious disease outbreaks. Moreover, there is a need to improve the relevant policies and equipment.

Keywords: disease outbreak, community health service centres, coping capacity, training

Plain Language Summary

What is Known on This Topic?

- There is an increasing risk of outbreaks of infectious diseases worldwide.
- The capacity of CHCs to cope with infectious disease outbreaks is essential and deserves more attention.

- Chinese CHCs have deficiencies with regard to coping infectious disease epidemics.

What This Study Adds?

- The ability of community medical staff to cope with the outbreak of infectious disease was measured in the aspects of regulation awareness, detection/reporting ability and handling ability.
- The scores for regulation awareness and detection/reporting ability were lower than the score for the ability to handle an epidemic.
- The three emergency response abilities of CHC medical workers differed based on the medical worker's sex, department, and professional title.
- To address outbreaks of infectious diseases, it is important to perform targeted scientific emergency exercise and training.
- It is important to improve emergency equipment at CHCs and generate targeted emergency response plans for infectious disease outbreaks.

Introduction

Many countries have an epidemic outbreak prevention and control system with clear institutional provisions and responsibilities for health institutions at all levels. However, in the actual emergency response to an epidemic, the role of primary medical institutions is more complex. Many developed countries have relatively sound emergency response systems for primary medical institutions. For example, in response to COVID-19,¹ Singapore's public health preparedness clinics have been tasked with distributing drugs, administering vaccines from national stockpiles, and providing subsidized treatment. In Singapore's established community-wide acute respiratory infection surveillance system,² these clinics are responsible for closely monitoring health personnel and patients and reporting cases to the Ministry of Health. When suspected cases are detected, centralized screening, contact tracing, telephone monitoring, and isolation are planned, with public health preparedness clinics providing specialized isolation facilities for quarantined individuals who cannot be isolated at home.² If necessary, confirmed cases are referred to an infectious disease facility for evaluation and admission through the Singapore Emergency Hotline (995). In the United Kingdom, general practitioners assess and manage most confirmed COVID-19 cases remotely during the epidemic and, if necessary, conduct face-to-face visits in designated locations (ie,

general practitioners' offices or isolation centres) or at the patient's home.^{3,4} General practitioners divide undiagnosed isolated patients into those with urgent care needs and those requiring basic routine care, conducting follow-up as required.^{5,6}

Under the Chinese system, primary responsibility for the prevention and control of infectious diseases lies with the Centre for Disease Control and Prevention. However, the participation of community health centres (CHCs) is limited. After the SARS outbreak in 2003, China issued The Guidelines for the Preparation of Community (Township) Emergency Plans for Public Health Emergencies (Trial), which specified the responsibilities of CHCs in response to public health incidents such as infectious disease emergencies.⁷ Before the COVID-19 outbreak, Key Points of Primary Health Care in Shanghai 2020, issued by the Shanghai Municipal Health Commission, indicated that CHCs should play a role in the epidemic prevention and control network by participating in surveillance and reporting, the isolation and referral of patients with suspected cases, and community health education.⁸ However, during the epidemic, CHCs have been hindered by vulnerabilities such as a lack of emergency funds and supply reserves, insufficient professional and technical personnel, and limited means of disseminating information, which have constrained their ability to participate in epidemic prevention in the community.

In terms of the existing literature, some qualitative studies have pointed out the roles and deficiencies of Chinese CHCs with regard to the prevention and control of infectious diseases. For example, prior research summarized the role of CHCs in health education, infectious disease prevention and control training, community supervision and guidance, epidemic situation monitoring, and other aspects of infectious disease prevention and control.⁹ In an investigation of infectious disease prevention and control in 90 CHCs, the researchers concluded that CHCs currently have deficiencies in health education, the management of continuous monitoring of the epidemic situation and the population, infection source detection, and vector control.¹⁰ There is also evidence that CHCs have been hindered by similar shortages during the COVID-19 epidemic.¹¹ To date, no quantitative studies have assessed the emergency response capability of CHC medical personnel in the case of an infectious disease outbreak.

The purpose of this cross-sectional study was to analyse the regulation awareness, detection and reporting

ability, and handling ability of community medical staff in response to a communicable disease outbreak and to identify the key obstacles to an adequate response under the existing system. This study was conducted in Shanghai, which is the region in China with the highest level of development of the primary health system and can therefore serve as an example, providing a reference for improving the infectious disease prevention and control capacity of primary medical institutions elsewhere.

Methods

Data Source

This study was conducted in Shanghai. All administrative districts in Shanghai were categorized as urban, suburban, or rural, and stratified random sampling was used to select 16 CHCs in each type of district. All medical staff members in the selected CHCs were administered the questionnaire survey. A total of 2630 questionnaires were collected, including eight questionnaires with inconsistent or illogical answers and 162 from respondents who were not involved in epidemic prevention and control. Ultimately, 2460 valid questionnaires were retained, yielding an effective response rate of 93.54%.

Measurements

Following China's Novel Coronavirus Pneumonia Diagnosis and Treatment Plan (Trial, Fifth Edition),¹² we designed the Questionnaire on the Emergency Capacity of Community Health Centres under Epidemic Situations (ECCHC). The questionnaire was modified and improved through the Delphi method and other expert guidance. Our survey comprised three aspects of coping capacity during infectious disease epidemics: 1) awareness of laws and policies pertaining to the responsibilities of CHCs during infectious disease epidemics; 2) the ability to detect, report, and refer cases of infectious diseases (patient classification, reporting time, epidemiological investigation methods, reporting procedures, fever surveillance in the clinic, and preservation of patient samples); and 3) the ability to handle an infectious disease outbreak (self-protection measures, prevention of in-hospital infection, psychological adjustment, and patient follow-up management). A five-point Likert-type scale was used, with the following response options: 1= complete ignorance; 2= little knowledge; 3= basic knowledge; 4= familiar; and 5= very familiar. The score for each domain was calculated as the mean score of all items in that domain. Higher

scores correspond to better emergency response ability among the surveyed community health workers. The questionnaire also included items related to social and demographic characteristics, such as the staff member's sex, age, educational background, professional title, department, and number of years spent working in the medical institution (see [Appendix A](#) for full questionnaire).

From February 15 to February 29, 2020, we conducted a preliminary investigation. We distributed the questionnaire to all medical staff members in the selected CHCs through our professional network, and collected a total of 171 qualified questionnaires. To assess consistency, we calculated Cronbach's α (0.957), which showed that the questionnaire had good reliability. Exploratory factor analysis was carried out on the items in the three domains described above, and the Kaiser–Meyer–Olkin (KMO) and Bartlett's test results showed that the items were suitable for factor analysis (KMO= 0.968, $P < 0.001$). Principal component analysis with orthogonal rotation was conducted using the maximum variance method to obtain the component matrix after rotation. Each item was screened by referring to the common degree and factor load value. Three factors were extracted from the 16 questionnaire items, and the cumulative factor contribution rate was 83.58%. Each item had a strong loading on the corresponding factor, with loadings ranging from 0.352 to 0.816. Confirmatory factor analysis was used to compare the fit indices between the theoretical hypothesis model and the competing model. The fit indices of the theoretical model were better than those of the competing model. After correction, the chi-square value for the final measurement model was 3260.315 ($P < 0.001$), the RMSEA was 0.115, and the SRMR was 0.034. The fit indices all ranged from 0.90 to 1.00: NFI = 0.937, IFI = 0.938, TLI = 0.924, and CFI = 0.938. The consistency between each item and the relevant factor ranged from 0.764 to 0.937, indicating that the structural validity of the final revised measurement model was good. Therefore, we proceeded with administering the formal questionnaire survey from March 1 to March 31, 2020.

Statistical Analysis

The data were collected electronically and analysed with SPSS version 23.0 using frequency distribution tables, analysis of variance (ANOVA), and multivariate linear regression. The significance level was set at $P < 0.05$. Before one-way ANOVA, the Kolmogorov–Smirnov test

and Levene's test were used to test for normality and homogeneity of variance, respectively. The test results showed $P > 0.05$, indicating that the samples met the assumptions of normality and homogeneity of variance. Analysis of covariance was used to compare scores for the three domains (regulation awareness, detection and reporting ability, and epidemic-handling ability) with the total score. Multivariate linear regression was performed to explore the relationships of emergency training and exercises with the three ECCHC domain scores and the total score, controlling for the respondents' socio-demographic characteristics. Four multivariate linear regression models were used to explore the factors associated with these ECCHC scores.

Results

As shown in Table 1, among the respondents, 41.63% worked in a suburban area, 77.85% were women, 40.08% were aged 30–39 years, 75.73% had a bachelor's degree, 53.29% held an intermediate professional title, 33.82% worked in general practice departments, and 41.02% had worked in the CHC for 5 to 15 years. In terms of participation in emergency exercises and training for public health emergencies involving infectious diseases, 87.85% and 84.63% of the selected CHCs, respectively, participated in scheduled emergency exercises and training each year. Among the respondents, 80.53% had participated in emergency exercises, and 93.01% had participated in emergency training before the time of the survey.

Table 2 compares the three domain scores and the total ECCHC score according to the participants' socio-demographic characteristics. The mean scores for all three domains ranged from 3 (basic understanding) to 4 (familiar), indicating that the surveyed medical staff members had a basic level of coping capability in the case of an infectious disease outbreak, although their level of familiarity was not high. However, the respondents' self-assessments of their infectious disease regulation awareness and detection/reporting ability were lower than their self-assessments of their ability to handle infectious disease outbreaks, indicating the need to strengthen their basic knowledge of infectious diseases and their ability to detect and report infectious diseases. Furthermore, respondents with senior professional titles and those working in nursing departments were more likely to have

Table 1 Socio-Demographic Characteristics of the Respondents (N = 2460)

Variable	Group	N	%
Socio-demographic characteristics			
District	Urban	710	28.86
	Suburban	1023	41.63
	Rural	726	29.51
Sex	Male	545	22.15
	Female	1915	77.85
Age (years)	20–29	429	17.44
	30–39	986	40.08
	40–49	851	34.59
	≥50	194	7.89
Education	Junior college or below	466	18.94
	Bachelor	1863	75.73
	Master or above	131	5.32
Professional title	Junior	981	39.89
	Intermediate	1311	53.29
	Senior	168	6.83
Department	General practice	832	33.82
	Prevention and health care	361	14.67
	Traditional Chinese Medicine	196	7.97
	Rehabilitation medicine	59	2.40
	Medical Technology	212	8.62
	Nursing	471	19.15
	Other	329	13.37
Working years (years)	Less than 5	721	29.31
	5–15	1009	41.02
	16–25	519	21.10
	>26	211	8.57
Yearly emergency exercises	Yes	2161	87.85
	No	84	3.42
	Not sure	215	8.74
Participation in emergency exercises before 2020	Yes	1981	80.53
	No	479	19.47
Yearly emergency training	0	70	2.85
	1	685	27.85
	2	754	30.65
	3	171	6.95
	4	472	19.19
	Not sure	308	12.52
Participation in emergency training before 2020	Yes	2288	93.01
	No	172	6.99

Table 2 Comparison of ECCHC Scores by Participant Characteristics (N = 2460)

Variable	Group	Regulation Awareness Mean (SD)	Detection and Reporting Ability Mean (SD)	Handling Ability Mean (SD)	Total Mean (SD)
Socio-demographic characteristics					
District	Urban	3.63 (0.03)	3.67 (0.03)	3.78 (0.03)	11.08 (0.10)
	Suburban	3.64 (0.03)	3.66 (0.03)	3.79 (0.03)	11.09 (0.08)
	Rural	3.64 (0.04)	3.67 (0.03)	3.79 (0.03)	11.09 (0.10)
Sex	Male	3.71* (0.04)	3.73 (0.04)	3.80 (0.04)	11.24 (0.12)
	Female	3.61 (0.02)	3.64 (0.02)	3.78 (0.02)	11.04 (0.06)
Age (years)	20–29	3.54 (0.05)	3.60 (0.05)	3.70 (0.05)	10.84 (0.14)
	30–39	3.63 (0.03)	3.67 (0.03)	3.79 (0.03)	11.09 (0.08)
	40–49	3.68 (0.03)	3.68 (0.03)	3.83 (0.03)	11.19 (0.08)
	≥50	3.67 (0.07)	3.71 (0.07)	3.78 (0.06)	11.17 (0.18)
Education	Junior college or below	3.61 (0.04)	3.60 (0.04)	3.71 (0.04)	10.92 (0.12)
	Bachelor	3.65 (0.02)	3.68 (0.02)	3.81 (0.02)	11.14 (0.06)
	Master or above	3.54 (0.07)	3.64 (0.07)	3.77 (0.07)	10.95 (0.19)
Professional title	Junior	3.56 (0.32)	3.60 (0.03)	3.70 (0.03)	10.86 (0.09)
	Intermediate	3.68 (0.02)	3.70 (0.02)	3.83 (0.02)	11.22 (0.07)
	Senior	3.68** (0.08)	3.73* (0.73)	3.94*** (0.07)	11.36** (0.21)
Department	General practice	3.69 (0.03)	3.75 (0.03)	3.85 (0.03)	11.29 (0.09)
	Prevention and health care	3.69 (0.05)	3.72 (0.05)	3.80 (0.04)	11.20 (0.13)
	Traditional Chinese Medicine	3.50 (0.06)	3.49 (0.06)	3.69 (0.06)	10.67 (0.17)
	Rehabilitation medicine	3.64 (0.13)	3.55 (0.13)	3.77 (0.13)	10.96 (0.36)
	Medical Technology	3.51 (0.07)	3.50 (0.06)	3.61 (0.06)	10.63 (0.18)
	Nursing	3.70** (0.04)	3.75*** (0.05)	3.86*** (0.04)	11.31*** (0.12)
	other	3.52 (0.05)	3.51 (0.05)	3.68 (0.05)	10.71 (0.15)
Working years (year)	Less than 5	3.56 (0.04)	3.63 (0.03)	3.75 (0.03)	10.95 (0.10)
	5–15	3.63 (0.03)	3.65 (0.03)	3.76 (0.03)	11.04 (0.08)
	16–25	3.72 (0.04)	3.73 (0.04)	3.85 (0.04)	11.29 (0.11)
	>26	3.72* (0.07)	3.71 (0.06)	3.85 (0.06)	11.29 (0.17)
	Emergency exercises and training for public health emergencies involving infectious diseases				
Yearly emergency exercises	Yes	3.71*** (0.02)	3.73*** (0.02)	3.84*** (0.02)	11.28*** (0.06)
	No	3.17 (0.09)	3.26 (0.81)	3.45 (0.08)	9.88 (0.24)
	Not sure	3.07 (0.05)	3.16 (0.02)	3.35 (0.05)	9.58 (0.14)
Participation in emergency exercises before 2020	Yes	3.76*** (0.02)	3.78*** (0.02)	3.88*** (0.02)	11.41*** (0.06)
	No	3.12 (0.04)	3.22 (0.04)	3.41 (0.04)	9.74 (0.10)
Yearly emergency training	0	3.17 (0.12)	3.18 (0.11)	3.34 (0.11)	9.69 (0.33)
	1	3.49 (0.03)	3.53 (0.03)	3.67 (0.03)	10.70 (0.09)
	2	3.74 (0.03)	3.76 (0.03)	3.87 (0.03)	11.37 (0.09)
	3	3.96 (0.06)	3.94 (0.06)	4.03 (0.06)	11.92 (0.18)
	4	3.97*** (0.05)	3.99*** (0.04)	4.07*** (0.04)	12.03*** (0.13)
	Not sure	3.12 (0.05)	3.19 (0.05)	3.37 (0.49)	9.68 (0.13)
Participation in emergency training before 2020	Yes	3.69*** (0.02)	3.71*** (0.02)	3.83*** (0.18)	11.23*** (0.05)
	No	2.94 (0.06)	3.06 (0.06)	3.23 (0.06)	9.23 (0.16)
Total		3.64 (0.02)	3.66 (0.02)	3.79 (0.02)	11.09 (0.05)

Notes: ECCHC stands for Questionnaire on the Emergency Capacity of Community Health Centres under Epidemic Situations; * $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$.

higher ECCHC scores on the three domains and overall than respondents with junior or intermediate professional titles and those working in other departments. In addition, men and medical personnel who had worked at the CHC for more than 26 years had relatively high scores on basic knowledge of infectious diseases. The interviewed medical staff members who worked at CHCs that carried out emergency exercises and training regarding infectious diseases and those who participated in these programs had higher scores on the three domains and higher total ECCHC scores than CHC medical staff members who did not participate in emergency exercises or training. Medical staff members' total scores and their scores on the three domains were significantly higher at CHCs that conducted more frequent emergency trainings.

As shown in Table 3 (Model 4), the results of a multiple linear regression model showed that the regular administration of emergency exercises or trainings pertaining to infectious disease outbreaks at CHCs and individual staff member participation in these programs were significantly correlated with the total ECCHC score. Compared with working in other departments, working in traditional Chinese medicine ($\beta = -0.63$, $P = 0.002$) or medical technology ($\beta = -0.60$, $P = 0.002$) departments was associated with a lower total ECCHC score. The results of models 1–3 showed that the participants' scores on the three dimensions of the ECCHC (regulation awareness, detection and reporting ability, and ability to handle an epidemic) tended to be consistent with the total score. More specifically, models 1–3 showed that medical workers in traditional Chinese medicine or medical technology departments had lower scores on all three domains and that participation in emergency exercises or training pertaining to infectious diseases was significantly positively correlated with each of the three domain scores. Furthermore, medical workers with senior professional titles were more likely to have a higher scores on their ability to handle an epidemic ($\beta = 0.21$, $P = 0.01$) than workers with junior or intermediate professional titles, and female medical workers were more likely to have lower scores on regulation awareness ($\beta = -0.11$, $P = 0.02$) and detection/reporting ability ($\beta = -0.11$, $P = 0.01$) than male workers.

Discussion

With the increasing risk of infectious disease outbreaks around the world, the role of CHCs in the prevention and control of the community transmission of infectious

diseases has become increasingly prominent. Although CHCs' functions with regard to epidemic prevention and control have been clarified, some vulnerabilities remain in their actual response to infectious disease outbreaks. We compared ECCHC domain scores in different regions of Shanghai and found that the scores for all domains were moderately high, which indicates that the surveyed medical staff members had a basic foundation with regard to the emergency response to an infectious disease outbreak. This finding can be explained by the early participation of Shanghai's CHCs in the development of basic public health services. Because of that early participation, the public health services involved in handling infectious diseases, such as health education services and the system of managing infectious diseases in the community, are relatively mature. We also found that participating in training and exercises pertaining to the emergency response to an infectious disease outbreak had a significant positive impact on the respondents' total scores and domain scores. Furthermore, community medical staff members with senior professional titles had relatively stronger abilities to handle emergency outbreaks of infectious diseases, likely because of their high levels of professional skill and robust clinical experience. Moreover, male medical workers scored higher than female workers regarding regulation awareness and detection/reporting ability. Therefore, assigning responsibilities to medical workers according to their professional title may improve the efficiency of epidemic prevention and control measures in CHCs' response plans for major infectious diseases. It is also worth noting that the average scores on regulation awareness and detection/reporting ability were lower than the average score on the ability to handle an infectious disease epidemic.

The relative weakness of the awareness of regulations regarding infectious diseases may suggest that community health workers lack specific knowledge of or experience with infectious diseases. In terms of educational content, training programs in CHCs conducted based on the professional knowledge available at the individual centres, and higher levels of specialization among medical staff members correspond to less complete mastery and a reduced ability to apply their professional skills outside of their specializations. For workers in traditional Chinese medicine or medical technology departments, emergency training was offered less frequently and was less relevant and of poorer quality than the training available to medical personnel working in other departments, which may have

Table 3 Linear Regression Models Predicting the Total ECCHC Score and Domain-Specific Scores (N = 2460)

Variable	Group	Model-1			Model-2			Model-3			Model-4		
		(Regulation Awareness)			(Detection and Reporting Ability)			(Handling Ability)			(Total)		
		β	T-Value	P-value	β	T-Value	P-value	β	T-Value	P-value	β	T-Value	P-value
Socio-demographic characteristics													
District	Rural	Ref.			Ref.			Ref.			Ref.		
	Suburban	0.08	1.91	0.06	0.06	1.45	0.15	0.05	1.16	0.25	0.19	1.59	0.11
	Urban	0.07	1.50	0.13	0.07	1.58	0.11	0.03	0.59	0.56	0.17	1.29	0.20
Sex	Male	Ref.			Ref.			Ref.			Ref.		
	Female	-0.11	-2.41	0.02	-0.11	-2.48	0.01	-0.03	-0.61	0.54	-0.24	-1.94	0.05
Age (years)	20-29	0.06	0.82	0.42	0.08	1.12	0.27	0.03	0.39	0.69	0.17	0.82	0.42
	30-39	0.05	0.96	0.34	0.07	1.38	0.17	0.03	0.66	0.51	0.15	1.05	0.29
	40-49	Ref.			Ref.			Ref.			Ref.		
	≥50	-0.08	-1.00	0.32	-0.01	-0.18	0.85	-1.22	-1.60	0.11	-0.22	-0.98	0.33
Education	Junior college or below	0.003	0.05	0.96	-0.05	-0.92	0.36	-0.04	-0.87	0.38	-0.09	-0.60	0.55
	Bachelor's	Ref.			Ref.			Ref.			Ref.		
	Master's or above	-0.002	-0.03	0.98	0.06	0.71	0.48	0.01	0.17	0.87	0.07	0.30	0.77
Professional title	Junior	Ref.			Ref.			Ref.			Ref.		
	Intermediate	0.09	1.83	0.07	0.05	1.18	0.24	0.09	1.97	0.05	0.23	1.74	0.08
	Senior	0.07	0.79	0.43	0.06	0.75	0.46	0.21	2.45	0.01	0.34	1.39	0.17
Department	General practice	Ref.			Ref.			Ref.			Ref.		
	Prevention and health care	0.01	0.19	0.85	-0.02	-0.30	0.76	-0.02	-0.42	0.68	-0.03	-0.18	0.86
	Traditional Chinese Medicine	-0.19	-2.68	0.01	-0.28	-4.02	<0.001	-0.16	-2.27	0.02	-0.63	-3.14	0.002
	Rehabilitation medicine	0.06	0.53	0.59	-0.11	-0.98	0.33	0.04	0.35	0.73	-0.008	-0.03	0.98
	Medical technology	-0.16	-2.33	0.02	-0.24	-3.50	<0.001	-0.20	-2.97	0.003	-0.60	-3.08	0.002
	Nursing	0.04	0.70	0.48	0.04	0.73	0.47	0.05	0.95	0.34	0.13	0.83	0.41
	Other	-0.11	-1.88	0.06	-0.19	-3.37	0.001	-0.12	-2.07	0.04	-0.42	-2.56	0.01

(Continued)

Table 3 (Continued).

Variable	Group	Model-1 (Regulation Awareness)			Model-2 (Detection and Reporting Ability)			Model-3 (Handling Ability)			Model-4 (Total)		
		β	T-Value	P-value	β	T-Value	P-value	β	T-Value	P-value	β	T-Value	P-value
		Working years (year)	Less than 5	0.02	0.43	0.67	0.06	1.21	0.23	0.07	1.55	0.12	0.15
	5-15	Ref.			Ref.			Ref.			Ref.		
	16-25	0.10	1.76	0.08	0.10	1.94	0.05	0.07	1.40	0.16	0.27	1.79	0.07
	>26	0.12	1.45	0.15	0.10	1.27	0.21	0.13	1.71	0.09	0.35	1.55	0.12
Yearly emergency exercises	Yes	Ref.			Ref.			Ref.			Ref.		
	No	-0.05	-0.46	0.64	-0.03	-0.28	0.78	0.003	0.03	0.98	-0.08	-0.26	0.80
	Not sure	-0.11	-1.33	0.18	-0.10	-1.28	0.20	-0.08	-1.08	0.28	-0.29	-1.30	0.20
Participation in emergency exercises before 2020	Yes	Ref.			Ref.			Ref.			Ref.		
	No	-0.32	-5.33	<0.001	-0.26	-4.39	<0.001	-0.20	-3.38	0.001	-0.78	-4.60	<0.001
Yearly emergency training	0	-0.31	-2.66	0.01	-0.38	-3.32	0.001	-0.35	-3.15	0.002	-1.04	-3.19	0.001
	1	-0.21	-4.55	<0.001	-0.20	-4.53	<0.001	-0.18	-4.04	<0.001	-0.60	-4.60	<0.001
	2	Ref.			Ref.			Ref.			Ref.		
	3	0.22	2.90	0.004	0.17	2.37	0.02	0.16	2.21	0.03	0.54	2.63	0.009
	4	0.22	4.23	<0.001	0.21	4.30	<0.001	0.20	3.97	<0.001	0.63	4.38	<0.001
	Not sure	-0.32	-4.54	<0.001	-0.33	-4.81	<0.001	-0.29	-4.30	<0.001	-0.94	-4.79	<0.001
Participation in emergency training before 2020	Yes	Ref.			Ref.			Ref.			Ref.		
	No	-0.23	-2.80	0.01	-0.17	-2.12	0.03	-0.13	-2.43	0.02	-0.59	-2.58	0.01
Adjusted R square		0.12			0.11			0.09			0.12		

Notes: ECCHC stands for Questionnaire on the Emergency Capacity of Community Health Centres under Epidemic Situations; Ref. indicates the reference group.

exacerbated the differences between departments in terms of their ability to respond to emergencies regarding infectious diseases. Finally, because of the lack of education and training, the basic level of professional knowledge and comprehensive ability to respond to an outbreak of an infectious diseases are not high among CHC staff members, which hinders the community-level response to such an outbreak.^{13–15} Prior studies have suggested that to improve the response capacity of staff members in non-clinical departments and CHC personnel who lack experience in the prevention and control of infectious diseases, it is necessary to strengthen systematic training, professional skills training, and continuing education, especially that pertaining to the prevention and control of infectious diseases.^{16–18}

The low scores for the capacity to detect and report cases of infectious disease may suggest that community health workers lack the training and experience needed to respond to infectious disease outbreaks. In Shanghai and other parts of China, CHCs independently carry out infectious disease detection and are obligated to report any detected cases to the Centre for Disease Control and Prevention. Timely, science-based, and orderly prevention and control measures taken by communities can quickly and effectively control an epidemic and reduce the pressure on hospitals; CHCs are important for directly and effectively guiding communities through the implementation of epidemic prevention and control measures.¹⁹ However, during the COVID-19 pandemic in China, professional testing equipment was lacking at the community level. CHCs were required to perform additional sampling and deliver those samples for testing, although the medical staff members in some departments, such as the traditional Chinese medicine and medical technology departments, had no relevant experience or training. In this context, the testing capacity was limited. In terms of the reporting system, although China has built the world's largest "online direct reporting system",²⁰ this system does not allow for early warnings. Because this direct network reporting system is not connected to the hospital information system, telephone or email reporting is used for the actual declaration process, resulting in a lack of sensitivity with regard to identifying the original source of the infection. Furthermore, only known infectious diseases are reported, which increases the difficulty of emergency reporting. Additionally, because of the lack of emergency exercises using the direct network reporting system, only those working in respiratory

departments and fever outpatient clinics are familiar with the system; many clinical front-line primary medical staff members know very little about this system, and the lack of knowledge is even more pronounced among those in non-clinical departments. In the context of the broader medical establishment in China, large hospitals continue to expand, while the primary care capacity remains insufficient. Therefore, in the early stage of an infectious disease outbreak, community medical workers find it difficult to detect the onset of a cluster among patients with common symptoms such as fever and cough who seek medical treatment at the CHC. In addition, the unclear hierarchical structure with regard to diagnosis and treatment leads to patients seeking care in an unsystematic and scattered way, which resulted in disorder in the medical treatment system after the outbreak of the COVID-19 epidemic and an insufficient ability of CHCs to report and refer cases. On the basis of international experience, effective planning can help CHC medical personnel take reasonable measures to mitigate the spread of an epidemic, especially in the early stage of an epidemic of a disease with an unknown cause, which could benefit both the community and the medical personnel.^{21,22} In addition, effective initial consultations in the community, a two-way referral system, and a system focused on family medicine could improve CHCs' prevention and control capacity during outbreaks of major infectious diseases.²¹ Family medicine practices are especially well positioned to improve the efficiency of epidemic prevention and control by increasing the compliance of community residents with disease screening, isolation, and management measures by promoting public awareness and providing education and psychological counselling related to infectious diseases.^{23–26}

Several study limitations must be taken into account. First, although the items used to measure awareness and ability with regard to infectious diseases were developed using careful expert consultation and confirmatory testing, the reliability and validity of these measures still need to be evaluated and improved through a large number of experiments. Second, the survey data used in this study were based entirely on self-report and thus may be subject to recall bias. Third, although the sample of medical staff members who completed the ECCHC was randomly selected in this cross-sectional study, we excluded respondents who were not involved in epidemic control and prevention, which may have caused sample selection bias.

Conclusion

Respondents in Shanghai's CHCs generally reported a moderately high score with regard to their emergency response ability. However, their scores on the three domains differed based on their sex, department, and professional title, indicating the need for targeted scientific emergency exercises and training programs. Additionally, the relevant policies and equipment should be improved, including more scientific emergency planning, more adequate testing facilities, the better use of CHCs as the first point of contact with the community, the construction of a dual referral system, and a greater level of reliance on family medicine practices. These improvements are necessary to ensure that CHCs act as the first line of defence with regard to epidemic prevention and control.

Data Sharing Information

The data sets during and/or analyzed during the current study available from the corresponding author on reasonable request.

Ethics and Consent

This study was approved by the ethics committees of Tongji University (ref: LL-2016-ZRKX-017). Official permission was obtained from selected hospitals and health centres. Confidentiality was kept and informed verbal consent was obtained from each study participants after explaining the purpose of the study. Verbal informed consent was approved by the Tongji University Research and Ethics Committee. This research was carried out in accordance with the principles of the Declaration of Helsinki.

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Author Contributions

All authors contributed to data analysis, drafting or revising the article, have agreed on the journal to which the article was submitted, gave final approval of the version to be published, and agreed to be accountable for all aspects of the work. Yan Yang and Ning Chen contributed to the work equally and were co-first authors. Wenya Yu and Jianwei Shi contributed to the work equally and were co-corresponding authors.

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Disclosure

The authors report no conflicts of interest in this work.

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