

A retrospective analysis of coping competence among community health centers during the COVID-19 pandemic in Shanghai, China: Coping strategies for future public health emergency events

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Abstract: This study aims to investigate the coping competence of 12 community health centers through nursing workforce, emergency preparation, emergency response training, and emergency support in a district of Shanghai during the coronavirus disease 2019 (COVID-19) pandemic in 2022 to propose coping strategies and implication for Future Public Health Emergency Events for community health centers. A cross-sectional survey was conducted on June 2022, and 12 community health centers (servicing a population of $104,472.67 \pm 41,421.18$, with 125 ± 36 health care providers per center) were then divided into group A ($n = 5$, medical care ratio $\geq 1:1$) and group B ($n = 7$, medical care ratio $< 1:1$) according to collected data, and the nursing human resources management and coping competence of the centers with COVID-19 of both groups were retrospectively analyzed. Nursing shortages were obvious across all 12 centers. Certain deficiencies in the coping competence of community health centers with emergencies must be addressed (possession rate $< 70\%$ in both groups, $p > 0.05$). Community health centers need to enhance hospital-to-hospital collaboration and the ability to transport emergency staff to the post promptly during outbreaks. Emergency coping assessments, emergency drills at different levels, and mental health support need to be implemented regularly among community health centers, and effective donation management should be pursued as well. We expect that this study could support efforts by leaders of community health centers to conclude coping strategies including increasing nursing workforce, optimizing human recourse management, and identifying areas of improvement of centers for emergency coping during public health events.

Keywords: COVID-19, community health centers, competence, coping strategies, nursing workforce

Introduction

Omicron has the characteristics of a short incubation period and rapid transmission. Patients may either experience respiratory tract infection, fever, and fatigue as the main clinical symptoms or an asymptomatic disease course, and the proportion of mild cases has increased and the hospitalization rate has decreased (1-3)

During the omicron pandemic in China, nucleic acid screening became the focus of diagnostic work, bringing severe challenges to primary healthcare institutions. Community health nurses are the main force of pandemic prevention at the primary level. They are responsible for significant tasks, such as nucleic acid sampling, specimen sorting and transportation, materials preparation, and donation management, which collectively require a significant workforce. At present, the nursing workforce of primary healthcare institutions is relatively insufficient. Especially in response to emergencies, it is urgent to have an efficient emergency nursing team (4).

Following the outbreak of omicron in Shanghai during April and May 2022, Shanghai faced huge challenges. This study investigated the coping status in the community health service in a district of Shanghai during the coronavirus disease 2019 (COVID-19) pandemic in 2022 and proposes coping strategies to provide inspiration and reference for the future management of public health emergencies.

Materials and Methods

General information

In June 2022, a questionnaire was delivered to assess the coping status with COVID-19 among 12 community health centers in a district of Shanghai. The subjects of the investigation comprised the director at each center, all of whom provided informed consent and were willing to cooperate with this study. To avoid interference with the results by suburban regional differences, the healthcare institutions included in this investigation were all urban

community health centers. In this paper, the research area and research unit are anonymized.

Methods

Survey tool

i) General information from the community health center investigation: The collected information included the service population of each community health center; the number of subordinate stations; the distance from stations to the center; the numbers of physicians, registered nurses; the staff structure; and the nursing workload during the pandemic, etc.

ii) Investigation of the coping status with COVID-19: The questionnaire was designed based on the Competency Index System of Reserve Team for emergency response to public health emergencies (5), an evaluation index of the coping competence of primary healthcare institutions, and an evaluation index of community competence in responding to public health emergencies (6-8). The questionnaire covered 3 aspects: emergency preparation, emergency response training, and emergency support. Among them, emergency preparation included 8 items, such as emergency post responsibilities, hospital-hospital cooperation, regular coping assessment, and prompt arrival of healthcare staff; emergency response training included 7 items, such as emergency plan manual, emergency training, emergency drill, and specialist in charge; and emergency support included 7 items, such as timely allocation of materials, effective transportation of positive patients, effective donation management, and mental health support. Each item could be responded to with "yes" or "no".

Data-collection method

The questionnaire was distributed using an online application called Questionnaire Star (Ranxing Information Technology Co.Ltd., Changsha, China). The researcher introduced the survey purpose, significance, and relevant filling instructions and sent the survey instructions and QR code through WeChat (Tencent Holdings Ltd., Shenzhen, China). An answer was required for each item. A total of 12 questionnaires were sent out and all 12 were recovered, as such, the questionnaire response rate was 100%.

Statistical method

SPSS version 27.0 (IBM Corporation, Armonk, NY, USA) was used for statistical analysis. Normally distributed measurement data are represented by mean and standard deviation values. An independent-samples *t* test was used for comparison between the groups. The measurement data and rank data that did not conform to a normal distribution are represented by Median (P25, P75), and the comparison of both groups was conducted by rank-sum testing of a pair of independent samples.

The count data are represented by *n* (%). The chi-squared test was used for comparison between the 2 groups, and the test level was $\alpha = 0.05$.

Ethical statement

This study was performed in accordance with the ethical standards of Declaration of Helsinki and its later amendments, and reviewed and approved by the ethical review board of Xinhua Hospital affiliated with Shanghai Jiaotong University School of Medicine, China. All participants gave their informed consent before data collection. This survey was conducted anonymously to ensure full protection of individual and organization privacy.

Results

General information on the nursing workforce in the community health centers

The service population of the 12 community service centers in this investigation totaled 104,472.67 \pm 41,421.18 people. Each center had 5 \pm 2 stations, and the total number of health care providers in each center was 125 \pm 36, which included 47.92 \pm 22.41 physicians and 45.08 \pm 15.28 registered nurses. The average medical and nursing ratio was 1:0.97, which is lower than the required standard medical care ratio of 1:1.5 for community hospitals set by the National Health Commission (9).

In this study, the 12 community health centers were divided into 2 groups according to the state of their nursing workforce, as follows: group A (*n* = 5, medical care ratio \geq 1:1) and group B (*n* = 7, medical care ratio < 1:1). In this study, the average medical care ratio of group A was 1:1.06, while that of group B was 1:0.89.

Nursing workforce of the community health centers during the COVID-19 pandemic

During the study period, in addition to their original nursing work, the nurses of the surveyed centers were also responsible for nucleic acid sampling of outpatient patients, nucleic acid sampling and screening of residents, specimen sorting and transportation, and management and preparation of materials and goods. As such, the nursing workload during the study period greatly exceeded the original (pre-pandemic) workload. As a result, each center has received support from nurses from other hospitals and community volunteers to complete these additional tasks.

The average number of support nurses from other hospitals at the 12 community health centers was 150 \pm 61, which was 3.3 times the average number of registered nurses in the centers. Also, the average number of volunteers (by community recruitment) at the 12 centers was 16. During the study period, all the volunteers were

primarily conducting non-medical work, such as QR code scanning and order maintenance. In addition, 3 community health service centers had hired retirees from the healthcare system (doctors/nurses) to participate in the support work; these retirees were mainly performing nucleic acid sampling. Only 4 of the 12 community health service centers (2 in group A and 2 in Group B) indicated that they had the capacity to send their nurses to other hospitals for support, while the remaining 8 centers indicated that they did not have the capacity to do so.

Nursing workload during the COVID-19 pandemic

During the COVID-19 pandemic, 29,251 ± 6,271 nucleic acid samples were collected by health service centers per day, and 937 ± 134 samples were collected by each community health nurse per day. The average time of nucleic acid sampling undertaken by each center was 9.45 ± 1.70 h, with the longest sampling time being 12.5 h and the shortest being 6.7 h. Community health nurses worked 8.08 ± 1.14 h/day, with the longest working time being 10.5 h/day and the shortest being 6.5 h/day. Comparisons of the nursing workforce and workload between groups A and B during the study period are shown in Table 1, and no statistical differences were apparent between the 2 groups (*p* > 0.05). Both groups presented a trend that the workload of nucleic acid sampling was heavy yet the nursing workforce was insufficient, and the capacity of the community health centers to send their nurses to support other hospitals needed to be improved.

Staff structure of nurses

The staff structure of nurses in these 12 centers and support nurses from other hospitals is shown in Table 2. The results show that up to 78% of the support nurses had the title of nurse or nurse practitioner (junior title), and 75.5% of the support nurses had < 10 working years. In other words, young nurses appear to have been the main force of pandemic support.

Coping status with the COVID-19 pandemic among

community health services centers

The questionnaire assessing coping status with the COVID-19 pandemic covered emergency preparation (8 items), emergency response training (7 items), and emergency support (7 items), as previously stated. All 22 items were summarized into good indexes (possession rate ≥ 70%) and insufficient indexes (possession rate < 70%) according to responses from the 12 health service centers.

The results showed that the coping competence with the COVID-19 pandemic among the 12 community health centers needs to be improved. The specific results of the analysis are as follows. In the category of emergency preparation, the possession rate of both groups was 85.71%–100% in the aspects of establishing healthcare staffs' responsibilities during the pandemic, having access to emergency reporting, and completing routine work during the pandemic. Conversely, 3 centers (60%) in group A and 2 centers (28.57%) in group B had the capacity to cooperate with other hospitals and send staff to the post in the case of emergencies promptly, while the other centers could not complete these actions (*p* > 0.05). Additionally, only 1 center (20%) in group A and 1 center (14.28%) in group B assessed the coping competence with emergencies regularly, while the

Table 2. Nursing staff structure of 12 centers and support nurses from other hospitals

Nursing staff structure	Constituent ratio (%)	
	Nurses of the centers	Nurses from other hospitals
Professional title		
Nurse	41.6	36.7
Nurse Practitioner	32.9	41.3
Supervisor Nurse	23.3	21.9
Associate Professor/ Professor of Nursing	2.2	0.1
Working years		
≤ 5	13.5	33.8
6–10	22.9	41.7
11–20	29.3	19.5
21–30	22.4	4.9
> 30	11.9	0.1

Table 1. Comparison of nursing workforce and workload between the 2 groups during the COVID-19 pandemic

Index	Group A (<i>n</i> = 5) Median (P25, P75)	Group B (<i>n</i> = 7) Median (P25, P75)	<i>z</i> / χ^2 value	<i>P</i>
Number of nurses in the center	45 (45, 51)	42 (32, 55)	1.311	0.190
Number of support nurses	150 (25, 475)	150 (15, 200)	0.407	0.684
Sampling persons/day/center	26,700 (22,784.5, 35823.5)	31,984 (23,562, 35,360)	0.081	0.935
Sampling persons/day/nurse	879 (822, 927)	996 (853, 1134)	1.218	0.223
Working hours/day/center	9.5 (8.75, 11.25)	10 (7.5, 11)	0.410	0.682
Working hours/day/nurse	7.5 (6.75, 9.75)	8.5 (7.5, 9)	0.331	0.741
Has the capacity to send their nurses for support?			-	> 0.999
Yes	2	2		
No	3	5		

remaining centers did not ($p > 0.05$). In the category of emergency response training, both groups had 85.71%–100% possession rates ($p > 0.05$) for the following: having an emergency plan manual, having a personal protection manual, being able to look up the plan online, carrying out emergency training and drills regularly, and having a specialist in charge. In contrast, no centers in either group carried out emergency drills at different levels to meet the varying needs of the pandemic; moreover, the contents of the current emergency drills were fixed, without accommodating situational changes ($p > 0.05$). Finally, in the category of emergency support, both groups had 71.42%–100% possession rates ($p > 0.05$) for rational deployment of protective materials, emergency equipment, medicines and goods, effective transportation of positive patient, and the transformation of infectious wards. However, only 2 centers (40%) in group A and 3 centers (42.85%) in group B indicated that they had effective donation management, while the remaining centers did not report having an effective plan, and only 2 centers (40%) in group A and 1 center (14.28%) in group B were providing mental health support for staffs ($p > 0.05$). Detailed data are shown in Table 3.

Discussion

Nursing workforce in community health centers

This study found that there was an insufficient nursing

workforce at the 12 surveyed community health centers, and the ratio of medical care was lower than the national standard of 1:1.5. In recent years, with the rapid development of national public health care, community health centers, as the bottom units of the "tri-level medical service system," are an important kind of institution from which community residents can obtain basic health care and public health services. The health care workforce is the first resource in the work of community health centers, among which the nursing workforce is an integral component (10).

Nursing shortages are highlighted as one of the biggest challenges to the effectiveness of health care systems. By the end of 2019, the number of registered nurses in China was 444,047, among which 202,408 were registered nurses working at community health centers; this number only accounts for 4.55% of the total number of registered nurses in China (11). According to Rui Wang's research, the ratio of community nursing staff in a district of Shanghai in 2020 was 1:1.09; although this ratio increased from that of 1:1.06 in 2016, it remained lower than the 1:1.5 required standard ratio set by the National Health Commission. Therefore, the current workforce of community nursing staff in China cannot meet the needs of residents desiring public health services (12).

During public emergencies, the nursing workforce of health care systems should be demand-oriented. During the COVID-19 pandemic, community health centers in Shanghai have faced great challenges. As

Table 3. Competence of coping with the COVID-19 pandemic of the study groups

Index	Group A (n = 5, %)		Group B (n = 7, %)		p
	Yes	No	Yes	No	
<i>Emergency preparation</i>					
Set up pandemic prevention posts	5 (100.00)		7 (100.00)		-
Set up position responsibilities	5 (100.00)		6 (85.71)		> 0.999
Set up hospital-hospital cooperative relationship	3 (60.00)		2 (28.57)		0.558
Has access to get emergency information	5 (100.00)		7 (100.00)		-
Has emergency reporting paths	5 (100.00)		6 (85.71)		> 0.999
Assesses coping competence regularly	1 (20.00)		1 (14.28)		> 0.999
Emergency staff can be transported to the post promptly	3 (60.00)		2 (28.57)		0.558
Completes routine work during pandemic	5 (100.00)		6 (85.71)		> 0.999
<i>Emergency response training</i>					
Has emergency plan manual	5 (100.00)		7 (100.00)		-
Has personal protection manual	5 (100.00)		7 (100.00)		-
The emergency plan can be looked up online	5 (100.00)		6 (85.71)		> 0.999
Holds emergency training regularly	5 (100.00)		7 (100.00)		-
Holds emergency drills regularly	5 (100.00)		7 (100.00)		-
Organizes emergency drills at different levels	0 (0.00)		0 (0.00)		-
Specialist in charge for relevant training	5 (100.00)		6 (85.71)		> 0.999
<i>Emergency support</i>					
Rational deployment of protective materials	5 (100.00)		7 (100.00)		-
Rational deployment of emergency equipment	4 (80.00)		5 (71.42%)		> 0.999
Rational deployment of emergency medicines and goods	5 (100.00)		7 (100.00)		-
Effective transportation of COVID-19-positive patients	4 (80.00)		6 (85.71)		> 0.999
Effective transformation to infectious ward	4 (80.00)		6 (85.71)		> 0.999
Effective donation management	2 (40.00)		3 (42.85)		> 0.999
Mental health support for healthcare staffs	2 (40.00)		1 (14.28)		0.523

pandemic work and routine work continue to coexist, community health nurses face superimposed workloads and significant work pressure, which places greater stress on nursing human resource management. This study found that, in the case of emergencies, 7 of the 12 surveyed community health service centers lacked hospital–hospital cooperation, 7 centers could not send staff to the post promptly, and there was a shortage of sending center nurses to other hospitals for support. Recruiting volunteers, retirees, and nurses from other hospitals has been an indispensable way to secure external support for primary healthcare institutions during the pandemic situation.

Under the current situation where sufficient community health nurses cannot be recruited in the short term, this study proposes to establish hospital–community cooperation in emergencies to promote hierarchical referral (13). It is suggested to use the human resources of general comprehensive hospitals to alleviate the shortage of community nurses and set up volunteer reserve teams. It is also necessary to organize regular emergency training for volunteers to strengthen their job cognition and personal protection knowledge.

Analysis of staff structure for support nurses

This study found that all 12 surveyed health service centers accepted nurses from other hospitals to participate in pandemic work, with 78% of the support nurses being nurses or nurse practitioners (junior title) and 75.5% of the support nurses having < 10 working years. The reasons for why most support nurses were junior nurses are as follows: the COVID-19 outbreak in Shanghai is more serious than prior COVID-19 outbreaks, and the need for support is huge. General hospitals with supporting capacity undertake many specialized tasks within the hospital, and nurses with specialized competence mainly include those with supervisor nurse titles and above, with working lives of > 10 years. Therefore, due to a high number of dispatched support tasks, hospitals usually adopt the mode of "bringing the new with the old" to ensure the routine operation of clinical specialties in the hospital. Throughout the COVID-19 pandemic, the common problem of community health centers and general hospitals has been exposed: faced with more severe public health emergencies, healthcare institutions have been unable to provide sufficient specialist nurses in a short time. This paper proposes that nursing managers attach great importance to the training of specialized nurses, establish an effective reserve team of specialists in emergencies (14), and strengthen the promotion of young nurses' specialized competence so as to improve their clinical competency as a whole.

Coping strategies with emergencies based on our survey of community health centers

This study found that the coping competence with emergencies at community health centers should be further improved. The results of this study showed that community health centers have deficiencies in organizing emergency drills at different levels and have ineffective management of donations, consistent with the results of previous research contending that organizational management, post division of workforce, staff response, emergency training, and materials management are the main weakness of primary healthcare institutions (15,16). Furthermore, this study found that the centers had deficiencies in coping assessment and mental health support of staffs, which are discussed as follows.

Assessment of coping with emergencies

This study found that 10 community health centers did not organize assessments of coping with emergencies. Nursing staff, who take on the largest proportion of work related to the COVID-19 outbreak, are the primary employees facing risks. Therefore, coping with emergencies is an important factor affecting the quality and efficiency of the work done during public health events (17). In 2001, the U.S. Centers for Disease Control and Prevention and the Columbia University School of Nursing cooperated to construct a coping competence framework in emergencies, which includes assessing theoretical knowledge, skill level, and specialized competency (18). Lin Y, *et al.* proposed in the evaluation index of the rescue competence of community health centers in public health emergencies that solid theoretical knowledge and rescue skills form an important basis for the rescue of public health emergencies, and a quantifiable evaluation of the response capacity is necessary for community health centers to optimize training content so as to improve the competence of coping with emergencies (18).

This paper suggests that community health centers should regularly evaluate the nursing response with emergencies. One possible evaluation tool is the Emergency Preparedness Information Questionnaire, which was developed by the Wisconsin Nurses Association in collaboration with the Department of Public Health and the Nursing Alliance. The Cronbach's α coefficient of this scale was verified to be 0.97, indicating good reliability and validity (19). Regular competence assessment can help leaders to identify deficiencies in the emergency response of a hospital so as to further optimize the content and mode of emergency training in community health centers.

Organize emergency drills at different levels

This investigation found that all 12 community health centers had emergency plans and carried out emergency drills, but they had not developed drills at different levels. It is a normal component of training at hospitals to formulate emergency plans and carry out corresponding drills. However, the current emergency plan content

is too simple, being mostly for the simulation of infectious patient transportation. This paper suggests that community health centers should organize more diverse emergency drills, including those covering mass screenings during outbreaks, regular screenings in non-key areas, and coping strategies for different symptom levels.

Effective management of donated medicines and goods

This study found that 8 community health service centers did not have a complete donation management plan. Since the Ministry of Civil Affairs issued the Notice on Charitable Donations under the Normal Situation of Epidemic Prevention and Control on May 14, 2020, social organizations have made a large number of charitable donations to medical institutions in accordance with the law and in an orderly way (20).

During the COVID-19 pandemic, community health centers, as the primary locations of large-scale nucleic acid testing, received donations for epidemic prevention and sympathy supplies (food and daily necessities) from people from all walks of life. In the face of such a large number of donations, it was a great challenge for centers to accept, distribute, place, and reserve them by reasonable and compliant management. This paper suggests that medical institutions establish a multi-departmental cooperation mechanism by referring to the donation management scheme proposed by Guo X, *et al.*, which might cover the assessment and approval of donated materials before use, registration during use, and in-hospital supervision after use. Effective closed-loop donation management can ensure the rational and efficient use of donated materials, thus improving the competence of coping with emergencies (21).

Mental health support for healthcare staffs

This study found that 9 community health centers did not set up mental guidance groups for healthcare staffs. The competence of coping with stress is an important aspect of mental health for health staffs, especially nursing staffs (22). Public emergency events are characterized by sudden disease outbreaks and high workloads, which can easily lead to a series of mental problems among healthcare staffs, such as anxiety, insecurity, and occupational burnout. Tomaszewska K, *et al.* investigated 118 front-line clinical nurses and found that high workloads, hospital and social expectations, separation from family members and working with COVID-19 is related to experiencing symptoms of burnout during pandemic (23). Wanat M, *et al.* pointed out that workload, working time, and working environment have been primary stressors in the work of frontline staffs during the COVID-19 pandemic. Healthcare institutions should pay close attention to the occupational burnout of frontline staffs under epidemic situations and take precise measures to provide mental health support to healthcare staffs (24).

It is highlighted by experiences with the COVID-19 pandemic that mental coping strategies and extensive prevention measures should be introduced. Special attention should be given to staffs who are younger and have less working experience (25). This study suggests that all centers set up mental counseling groups and conduct regular mental evaluations. Multi-disciplinary teams can be set up in community health centers to assist healthcare staffs with mental stress reduction, including by encouraging them to talk about possible concerns and confusion before support, regularly tracking the mental dynamics and mental needs actively receiving support, and assessing the mental status after they receive support (26). Healthcare institutions should implement psychological crisis interventions and provide professional mental counseling and emotional support so as to improve the psychological coping competence of healthcare staffs during emergencies.

Conclusion

There exists a nursing shortage in community health service centers in a district of Shanghai. Hospital-hospital cooperation and prompt staff transportation to posts in emergencies need to be strengthened. These centers should regularly implement coping assessments, organize emergency drills at different levels, develop effective donation management protocols, and set up mental guidance groups so as to effectively improve the competency of coping with emergencies in community health centers to ensure that primary healthcare institutions play a more effective role in future public health emergencies.

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