ORIGINAL RESEARCH

Management of SARS-CoV-2 Omicron Variant Community Screenings in Shanghai, China: A Cross-Sectional Study

Keyu Chen [1],*, Bin Xu[2],*, Yifan Tang[3], Juan Cao[1], Rong Wang[3], Yali Tian[3], Chunhong Gao[3], Ming Chu[4]

[1]Department of Thoracic Surgery, Jiangsu Province Hospital and The First Affiliated Hospital of Nanjing Medical University, Nanjing, 210029, People's Republic of China; [2]Neurosurgical Intensive Care Unit, Jiangsu Province Hospital and The First Affiliated Hospital of Nanjing Medical University, Nanjing, 210029, People's Republic of China; [3]Nursing Department, Jiangsu Province Hospital and The First Affiliated Hospital of Nanjing Medical University, Nanjing, 210029, People's Republic of China; [4]Department of Nosocomial Infection, Jiangsu Province Hospital and The First Affiliated Hospital of Nanjing Medical University, Nanjing, 210029, People's Republic of China

*These authors contributed equally to this work

Correspondence: Chunhong Gao, Nursing Department, Jiangsu Province Hospital and The First Affiliated Hospital of Nanjing Medical University, 300 Guangzhou Road, Nanjing, Jiangsu Province, People's Republic of China, Tel +862568305379, Email gao22095@163.com; Ming Chu, Department of Nosocomial Infection, Jiangsu Province Hospital and The First Affiliated Hospital of Nanjing Medical University, 300 Guangzhou Road, Nanjing, Jiangsu Province, People's Republic of China, Tel +862568306917, Email chuming@njmu.edu.cn

Background: Community screening for SARS-CoV-2 Omicron variant plays a significant role in controlling the spread of infection. However, loopholes may exist in the current management of community screening in Shanghai, China. The objective of this study was to discover loopholes in the management of community screening for SARS-CoV-2 Omicron variant in Shanghai, China and provide targeted solutions.

Methods: The cross-sectional study was carried out April 4 to April 30, 2021, among residential committee directors from the Putuo District, Pudong District, and Minhang District of Shanghai, China. Data were collected using a self-designed questionnaire about the management of nucleic acid testing (NAT) sampling in communities through the network platform powered by www.wjx.cn.

Results: A total of 203 residential committee directors responded to the survey. Of them, 47.3% were not accepted training and 40.4% were not aware of cross-infection. Comparison among sampling sites and communities, high-risk group contained lower proportion of community training (P = 0.093~0.200), higher awareness of cross-infection (P = 0.039~0.777), more medical workers (P = 0.007~0.724) and more tests performed (P = 0.001~0.992). Larger communities had more medical workers, sampling sites, sampling tables (P = 0.000) and higher awareness of cross-infection (P = 0.009), but lower proportion of community training (P = 0.051).

Conclusion: Overall, community training and awareness of infection control were inadequate. Government or institutions should organize the community training and raise the awareness of infection control. Significant differences exist in NAT management patterns between sampling sites, as well as communities of different sizes. Residential community directors minimize high-risk sampling point settings in the future. Special personnel designated by the government or institutions should tour to guide each sampling site.

Keywords: community screening, SARS-CoV-2 Omicron variant, management, China

Introduction

COVID-19 is a disease caused by a novel coronavirus called severe acute respiratory syndrome coronavirus (SARS-CoV-2) that is liable for causing the global pandemic. On December 31, 2019, WHO first learned of this new virus from a group of viral pneumonia cases reported in Wuhan, China.[1] It was 26 November 2021 that WHO declared that the world was facing Omicron variant of concern.[2] Omicron has been identified as being significantly more transmissible, which altered the trajectory of the COVID-19 pandemic and replaced Delta as the dominant variant.[2]

111

Confirmed transmission routes of COVID-19 are direct transmission, aerosol transmission and contact transmission.[3] The main clinical manifestations of COVID-19 are fever, malaise and dry cough. According to data released by WHO, there have been more than 600 million confirmed cases of COVID-19 and approximately 15 million direct and indirect deaths due to COVID-19 globally in 2020 and 2021, which is nearly three times the number of deaths reported by countries worldwide.[4,5]

COVID-19 pandemic particularly the variant strains has hugely impacted all aspects of life. The impact of this pandemic is so severe that it has shaken most countries' s economies.[6,7] Problems and difficulties were quite outstanding in areas such as employment, social security, income, education, medical service, housing and production safety.[8–10]

Health professionals were discovering SARS-COV-2's traits, whereas with the evolving understanding of the disease, initiatives and interventions also needed to be continuously evaluated and updated.[11] Hence, the Chinese government adopted a "Dynamic COVID-zero" strategy to control Omicron variant spreading for the safety of people's lives and property, which includes early identifying infections, rapid containment and breaking the transmission chain through community screening.[12] From March 1 to April 26, 2022, a total of 535,600 local SARS-CoV-2 Omicron variant infections were reported in Shanghai, China. Community screening has proven effective in epidemic prevention and control in Shanghai's fight against the SARS-CoV-2 Omicron variant.[13] However, the number of confirmed cases of the Omicron variant remained high for almost two months, indicating some possible loopholes in community screening. Therefore, this study aimed to analyze the weak links of the management of NAT sampling in communities in Shanghai, China, through a cross-sectional survey and provide targeted solutions for improving the efficacy of community screening in preventing and controlling SARS-CoV-2 Omicron variant infection.

Materials and Methods
Participants
Convenience sampling was used to conduct a cross-section study from April 4 to April 30, 2021, that included residential committee directors from the Putuo District, Pudong District, and Minhang District of Shanghai, China, who were invited to answer the questionnaire by telephone. They organized NAT sampling in their own community. The sample size is usually calculated based on 5–10 times of the number of independent variables.[14] Considering the loss of follow-up of 20%, the final confirmed sample size is 220.

Questionnaire About Community Screening with Nucleic Acid Testing
Respiratory physicians, infection-control physicians, and nurses designed the questionnaire used in this study. The questionnaire covered 20 items related to community screening management efforts during the SARS-CoV-2 Omicron variant pandemic and included questions about community NAT sampling, such as the number of community logistic staff members, sampling sites, sampling table spacing, sampling interval, site layout, and related training.

Procedures
The self-designed questionnaire was uploaded to the online platform powered by www.wjx.cn, a platform functionally equivalent to Amazon Mechanical Turk. Participants filled the questionnaire through a Chinese social media platform called WeChat. A fully completed questionnaire was regarded as valid. All questionnaire results were anonymous and confidential. This study was performed in accordance with the tenets of the Declaration of Helsinki and was approved by the ethics committee of The Second Hospital of Nanjing.

Data Analysis
Raw data were downloaded through www.wjx.cn and data analysis was carried out using the Chinese version of SPSS 22.0. A value of $P < 0.05$ was taken as statistically significant. Normally distributed measurement data were shown as the mean ± standard deviation, and non-normally distributed measurement data were shown as the median and interquartile range. Enumeration data were shown as the number (n) and percentage (%). The chi-square and rank sum tests were used to analyze the differences between different patterns of community screening.

Results

Sample Characteristics

A total of 220 questionnaires were distributed to 220 participants, and 203 valid questionnaires were finally collected from 203 participants (response rate: 92.27%). Table 1 shows participant characteristics.

Table 2 shows community management patterns during the SARS-CoV-2 Omicron variant pandemic identified from 203 participants. Most study participants had a bachelor's degree, and 12.3% had a medical education background. To our surprise, 47.3% were not trained in NAT procedures, and 40.4% were not aware of cross-infection, which might be due to the suddenness of the SARS-CoV-2 Omicron variant outbreak. Figure 1 shows the common layouts of community NAT sites.

Comparison Among Sampling Sites

When comparing sampling sites, if multiple medical workers served at one sampling table, they were classified into the high-risk group; if one medical worker served at one sampling table, they were classified into the low-risk group. The number of tables at different sampling sites is displayed in Table 3. With more sampling tables in a single sampling site, more health care workers sampled (P = 0.000), it may mean more people lived here. The number of total sampling tables was significantly higher in cases of fewer sampling sites (P = 0.035). Restricted by the area of the community, the number of tables at each sampling site increased to strike a balance, as the number of sampling points was reduced.

The number of medical workers serving one table per sampling site is displayed in Table 4. Compared with the low-risk group, the high-risk group contained a significantly lower proportion of trained community logistic staff members (P = 0.093) and higher awareness of cross-infection (P = 0.159). These results may be due to sample size.

The medical workers classified according to the distance between two tables per sampling site are displayed in Table 5. The results showed that the high-risk group performed significantly more tests (P = 0.001) and contained significantly more medical workers (P = 0.007) than the low-risk group. Furthermore, compared with the low-risk group,

Table 1 Characteristics of 203 Residential Committee Directors

Sample Information	Number	Percentage
Age, yr		
<30	5	2.4
30–40	103	50.7
41–50	82	40.3
>50	13	6.4
Sex		
Female	110	54.2
Male	93	45.8
Educational background		
Junior	55	27
Bachelor	141	69.4
Master	6	2.9
Doctor	1	0.4
Medical background		
Yes	25	12.3
No	178	87.7
Community training		
Yes	107	52.7
No	96	47.3
Awareness of cross-infection		
Yes	121	59.6
No	82	40.4

Table 2 Infection Prevention and Control Management Patterns During the SARS-CoV-2 Omicron Variant Pandemic: Results from 203 Valid Questionnaires

Items	Total
Number of samplings	383,601
Number of community staff members	2965
Number of medical workers	750
Number of sampling sites	575
Number of sampling tables	743
One meter spacing, n (%)	
Yes	192 (94.6)
No	11 (5.4)
One-way flow, n (%)	
Yes	174 (85.7)
No	29 (14.3)
One table per sampling site	
One medical worker	375 (87.82)
Some medical workers	52 (12.18)
Two table per sampling site	
Spacing≥1.5m between sampling stations	158 (69.30)
Spacing<1.5m between sampling stations	70 (30.70)
More than two table per sampling site	
Spacing≥1.5m between sampling stations	63 (71.59)
Spacing<1.5m between sampling stations	25 (28.41)

the high-risk group had a lower proportion of trained community logistic staff members (P = 0.194) and a higher awareness of cross-infection (P = 0.777), although these were not statistically significant.

Comparison Among Communities

According to the distance between sampling tables, those serving at tables separated by ≥1.5 m were classified into the low-risk group, otherwise they were classified into the high-risk group.[15] Comparisons among communities of different sizes are displayed in Table 6. The results indicated that larger communities had significantly more medical workers, sampling sites, and sampling tables than smaller communities (P = 0.000). It was interesting that increasing community size was significantly associated with a smaller proportion of trained community members (P = 0.051) but a higher awareness of cross-infection (P = 0.009).

In communities with a residential population <1000, the high-risk group showed a significantly higher awareness of cross-infection than the low-risk group (P = 0.039) (Table 7).

In communities with 1000–3000 residents, there were more medical workers in the high-risk group (P = 0.023) (Table 8).

In communities with >3000 residents, there were significantly less sampling sites in the high-risk groups (P = 0.024) (Table 9).

Discussion

As the government reported on April 26, 2022, the majority of COVID-19 cases in Shanghai were caused by the Omicron BA.2 and BA.2.2 variants. Early identification and isolation of infected patients are the key to controlling SARS-CoV-2 infection by the Omicron variant. NAT is the standard diagnostic criterion for the disease. On March 18, 2022, the Chinese government released the guidelines for organizing regional COVID-19 screening (the third edition).[13] From March 10 to April 17, 2022, Shanghai conducted 13 community screening rounds involving more than 200 million
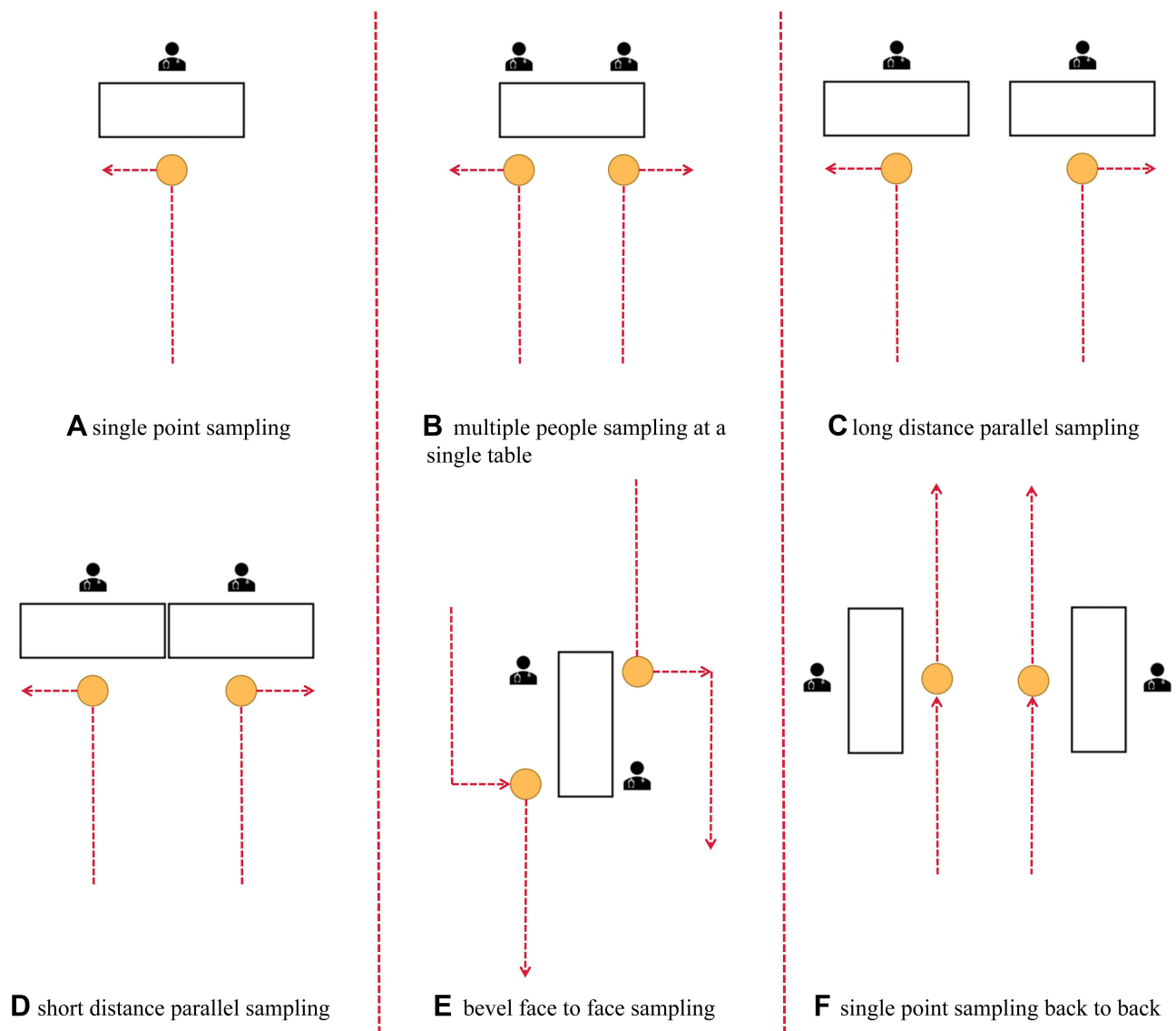
Figure 1 The common layouts of community NAT sites.

Notes: (**A**) There is only one sampling table and medical worker at a single sampling site. (**B**) There is only one sampling table at a single sampling site, with multiple medical workers taking samples and residents not facing each other at the time of sampling. (**C**) There are multiple sampling tables at a single sampling site, with multiple medical workers taking samples. The distance between sampling tables is more than 1.5m, and the residents are not face to face during sampling. (**D**) There are multiple sampling tables at a single sampling site, with multiple medical workers taking samples. The distance between sampling tables is less than 1.5m, and residents are not face to face during sampling. (**E**) There is only one sampling table at a single sampling site, with multiple medical workers taking samples and residents facing each other at the time of sampling. (**F**) There are multiple sampling tables at a single sampling site, with multiple medical workers taking samples and residents sitting back to back during sampling.

people.[16] By unswervingly adhering to the general policy of "Dynamic COVID-zero", the number of new daily infections in Shanghai has continued to decline. The authors of the present study had accomplished 14 community screening rounds in Shanghai from April 4 to May 7, 2022. Through this study, we discovered loopholes in the community screening organization.

SARS-CoV-2 is most likely transmitted via droplets, aerosols, or direct person-to-person contact.[17,18] How to properly wear and remove protective equipment, including hazmat suits and N95 masks, is critical for the prevention of cross-infection between medical workers or between patients and medical workers. N95 masks protect the wearer from droplets or aerosols that contain infectious agents.[19–21] Studies found that 27% of health workers who deviated from the training protocol and 79% of healthcare workers were contaminated in doffing personal protective equipment.[22,23] The risk of contamination was closely related to inappropriate hand hygiene and mishandled or compromised personal

Table 3 Comparison of Number of Tables per Sampling Site

Sample Information	1 Table	2 Tables	>2 Tables	P-value
Number of samplings	1290.00 (734.00, 2092.50)	2230.00 (1282.50, 3213.00)	2376.50 (2149.75, 3489.00)	0.000
Number of community staff members	10.00 (6.00,18.00)	10.00 (8.00,15.00)	15.50 (10.50,20.75)	0.116
Number of medical workers	2.00 (2.00,4.00)	4.00 (2.00,6.00)	5.50 (4.00,7.00)	0.000
Number of sampling sites	2.50 (2.00,4.00)	2.00 (1.00,3.00)	2.00 (1.00,2.00)	0.035
Number of total sampling tables	2.50 (2.00,4.00)	4.00 (2.00,6.00)	5.50 (2.00,6.75)	0.000

Note: All values are written as median (IQR).
Abbreviation: IQR, interquartile range.

Table 4 Comparison of Low-Risk and High-Risk Groups in One-Table Sampling Sites

Sample Information	Low-Risk Group*	High-Risk Group[†]	P-value
Number of samplings	1266.50 (710.75, 2097.50)	1339.00 (795, 2039.50)	0.950
Number of community staff members	11.50 (6.00,18.00)	10.00 (7.50,15.25)	0.609
Number of medical workers	2.00 (2.00,4.00)	4.00 (2.00,5.25)	0.075
Number of sampling sites	3.00 (2.00,4.00)	2.00 (1.00,4.00)	0.109
Number of sampling tables	3.00 (2.00,4.00)	2.00 (1.00,4.00)	0.109
Community training			
Yes	67 (55.8)	8 (36.4)	0.093
No	53 (44.2)	14 (63.6)	
Awareness of cross-infection			
Yes	68 (56.7)	16 (72.7)	0.159
No	52 (43.3)	6 (27.3)	

Notes: All values are presented as median (IQR) or n (%). *One medical worker served at one sampling table. †Multiple medical workers served at one sampling table.
Abbreviations: IQR, interquartile range; n, number.

Table 5 Comparison of Low-Risk and High-Risk Groups in Sampling Sites with Two Tables Spaced 1.5m Apart

Sample Information	Low-Risk Group*	High-Risk Group[†]	P-value
Number of samplings	1727.50 (978.50, 2656.00)	3800.00 (3013.00, 5800.00)	0.001
Number of community logistic staff members	11.00 (8.00,15.00)	10.00 (8.00,30.00)	0.401
Number of medical workers	3.00 (2.00,5.25)	6.00 (4.00,13.00)	0.007
Number of sampling sites	2.00 (1.00,3.00)	3.00 (2.00,4.00)	0.126
Number of total sampling tables	4.00 (2.00,6.00)	6.00 (4.00,8.00)	0.126
Community training			
Yes	20 (58.8)	4 (36.4)	0.194
No	14 (41.2)	7 (63.6)	
Awareness of cross-infection			
Yes	20 (58.8)	7 (63.6)	0.777
No	14 (41.2)	4 (36.4)	

Notes: All values are presented as median (IQR) or n (%). *One medical worker served at one sampling table. †Multiple medical workers served at one sampling table.
Abbreviations: IQR, interquartile range; n, number.

protective equipment (especially exposed hands and wrists). In less experienced personnel, the incidence of contamination was even greater.[8]

    Community logistic staff are mainly responsible for on-site management of NAT sampling, such as setting warnings and guidance signs. The results of this survey showed that nearly half of the community logistic staff had received no professional training, particularly in big communities, and 40.4% had no awareness of cross-infection. The risk of infection increased in NAT sampling organized by community workers who lacked training. To solve this problem,

Table 6 Comparisons Among Communities of Different Sizes

Sample Info	The Number of Residents <1000	The Number of Residents 1000~3000	The number of Residents >3000	P-value
Number of community staff members	7.00(5.00,10.00)	12.00(8.00,16.00)	21.00(12.00,30.00)	0.000
Number of medical workers	2.00(1.00,2.00)	3.00(2.00,4.00)	7.00(6.00,10.00)	0.000
Number of sampling sites	1.00(1.00,2.00)	3.00(2.00,4.00)	4.00(3.00,7.00)	0.000
Number of total sampling tables	2.00(1.00,2.00)	3.00(2.00,4.00)	7.00(6.00,8.00)	0.000
Community training				
Yes	37(58.7)	58(55.2)	12(34.3)	0.051
No	26(41.3)	47(44,8)	23(65.7)	
Awareness of cross infection				
Yes	29(46.0)	65(61.9)	27(77.1)	0.009
No	34(54.0)	40(38.1)	8(22.9)	

Note: All values are presented as median (IQR) or n (%).
Abbreviations: IQR, interquartile range; n, number.

Table 7 Comparison of Low-Risk and High-Risk Groups in Communities with Less Than 1000 Residents

Sample Information	Low-Risk Group*	High-Risk Group†	P-value
Number of community staff members	592.50 (336.50, 859.00)	780.00 (325.50, 935.50)	0.992
Number of medical workers	7.00 (5.00,10.00)	6.00 (5.00,13.00)	0.137
Number of sampling sites	2.00 (1.00,2.00)	2.00 (2.00,2.00)	0.162
Number of sampling tables	2.00 (1.00,2.00)	1.00 (1.00,1.50)	0.053
Community training			
Yes	34 (62.96)	3 (33.33)	0.095
No	20 (37.04)	6 (66.67)	
Awareness of cross infection			
Yes	22 (40.74)	7 (77.78)	0.039
No	32 (59.26)	2 (22.22)	

Notes: All values are presented as median (IQR) or n (%). *Two tables spaced ≥1.5m. †Two tables spaced <1.5m.
Abbreviations: IQR, interquartile range; n, number.

Table 8 Comparison of Low-Risk and High-Risk Groups in Communities with 1000~3000 Residents

Sample Information	Low-Risk Group*	High-Risk Group†	P-value
Number of sampling	1858.00(1359.00, 2250.75)	1800.00(1339.00, 2300.00)	0.884
Number of community staff members	12.00(8.00,18.00)	10.00(8.00,12.00)	0.106
Number of medical workers	3.00(2.00,4.00)	4.00(3.00,6.00)	0.023
Number of sampling sites	3.00(2.00,4.00)	2.00(1.00,3.00)	0.075
Number of sampling tables	3.50(2.00,4.00)	3.00(2.00,4.00)	0.127
Community logistic staffs training			
Yes	52(57.78)	6(40.00)	0.200
No	38(42.22)	9(60.00)	
Awareness of cross-infection			
Yes	54(60.00)	11(73.33)	0.325
No	36(40.00)	4(26.67)	

Notes: All values are presented as median (IQR) or n (%). *Two tables spaced ≥1.5m. †Two tables spaced <1.5m.
Abbreviations: IQR, interquartile range; n, number.

Table 9 Comparison of Low-Risk and High-Risk Groups in Communities with More Than 3000 Residents

Sample Information	Low-Risk Group*	High-Risk Group†	P-value
Number of sampling	3723.50(3348.00, 4527.00)	4000.00(3483.00, 5660.50)	0.257
Number of community logistic staff members	22.50(19.00,30.00)	15.00(10.00,31.00)	0.371
Number of medical workers	7.00(5.75,8.50)	7.00(5.50,12.00)	0.724
Number of sampling sites	6.00(3.00,8.00)	4.00(2.00,4.50)	0.024
Number of sampling tables	7.00(6.00,8.00)	6.00(4.00,9.00)	0.302
Community logistic staff training			
Yes	7(31.82)	5(38.46)	0.689
No	15(68.18)	8(61.54)	
Awareness of cross-infection			
Yes	19(86.36)	8(61.54)	0.091
No	3(13.64)	5(38.46)	

Notes: All values are presented as median (IQR) or n (%). *Two tables spaced ≥1.5m. †Two tables spaced <1.5m.
Abbreviations: IQR, interquartile range; n, number.

training programs should be provided, including operation of personal protective equipment, disinfection, isolation, biosafety, sampling procedures and precautions, emergency treatment of occupational exposure, and early prevention in crowds.[4] Only after passing the training program can the community staff take their post.

A perfect allocation of medical workers should take full account of the number of residents in the community and the distribution of sampling sites. Communities should set up sampling sites according to the number of residents, the number of medical workers, and geographical transportation. The present study showed that in larger communities, the number of community logistic staff members, medical workers, sampling sites, and sampling tables were significantly greater than in smaller communities (P = 0.000). Sampling should be performed in open, well-ventilated and relatively independent sites, such as gymnasiums, exhibition halls, and school playgrounds. Outdoor sampling sites are encouraged when natural conditions permit. Each sampling site should be divided into a waiting area, sampling area, buffer zone, or others, to effectively disperse the residents. An area with hand hygiene facilities, full-length mirrors, and other protective devices for medical workers should be isolated from the sampling site. Each sampling site should provide clear guidelines concerning the one-way flow of personnel, sampling process, and other matters. In the present study, we observed risk of cross-infection at 19.78% of the sampling sites, due to <1.5 m distance between sampling tables and multiple medical workers at one table According to an expert consensus, the distance between sampling tables should be >1.5 m, and one person samples alone, or two people sample alternately at each sampling table.

This study had some limitations. As a cross-section study, the sample size was small, and the measurement data showed a skewed distribution, which may cause some bias in the results. All data in this study were obtained from community directors rather than volunteers, which may have affected the data. Furthermore, the study covered only three districts in Shanghai. Due to the lack of actual positive cases of infection in the community, no indexes were used to analyze the impact of NAT sampling management on positive infection in the community.

Conclusions

Overall, community training and awareness of infection control were inadequate. It is necessary for the government or institutions to organize the community training and raise the awareness of infection control. Significant differences exist in NAT management patterns between sampling sites, as well as communities of different sizes, such as the number of medical workers, awareness of cross-infection and the proportion of community training, etc. It indicates that residential community directors should organize NAT sampling according to the conditions of each community to minimize high-risk sampling point settings as much as possible in the future. Special personnel designated by the government or institutions should tour to guide each sampling site, standardize sampling operation, personal protection, cross infection prevention and control and other related work, and guide each sampling site to maintain on-site order.

Abbreviations

COVID-19, coronavirus disease 2019; SARS-CoV-2, severe acute respiratory syndrome coronavirus 2.

Data Sharing Statement

Authors can provide the data of this study upon reasonable request.

Ethics Approval and Consent to Participate

The study had been performed in accordance with the principles stated in the Declaration of Helsinki and approved by the Medical Ethics Committee of The Second Hospital of Nanjing (2021-LS-ky030). All participants were briefed on the purpose of the study, provided written informed consent for the questionnaire survey before the study started and had the right to stop or discontinue from the study at any time. This study will not disclose participants' personal identity and treated gathered information confidentially.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Funding

Disclosure

The authors report no conflicts of interest in this work.

References

1. World Health Organization. Pneumonia of unknown cause-China. Available from: https://www.who.int/emergencies/disease-outbreak-news/item/2020-DON229. Accessed January 5, 2020.
2. World Health Organization. One year since the emergence of COVID-19 virus variant omicron. Available from: https://www.who.int/news-room/feature-stories/detail/one-year-since-The-emergence-of-omicron. Accessed November 25, 2022.
3. Jiang JK, Vincent Fu Y, Liu L, Kulmala M. Transmission via aerosols: plausible differences among emerging coronaviruses. *Aerosol Sci Technol*. 2020;54(8):865–868. doi:10.1080/02786826.2020.1769020
4. World Health Organization. Coronavirus disease (COVID-19) pandemic. Available from: https://www.who.int/emergencies/diseases/novel-coronavirus-2019. Accessed December 5, 2022.
5. World Health Organization. Global excess deaths associated with COVID-19 (modelled estimates). Available from: https://www.who.int/data/sets/global-excess-deaths-associated-with-covid-19-modelled-estimates. Accessed May 5, 2022.
6. World Economic Forum. Global gender gap report 2021. Available from: https://www.weforum.org/reports/global-gender-gap-report-2021. Accessed March 30, 2021.
7. Power K. The COVID-19 pandemic has increased the care burden of women and families. *Sustainability*. 2020;16:67–73. doi:10.1080/15487733.2020.1776561
8. Pinchoff J, Austrian K, Rajshekhar N, et al. Gendered economic, social and health effects of the COVID-19 pandemic and mitigation policies in Kenya: evidence from a prospective cohort survey in Nairobi informal settlements. *BMJ Open*. 2021;11(3):e042749. doi:10.1136/bmjopen-2020-042749
9. Burzynska K, Contreras G. Gendered effects of school closures during the COVID-19 pandemic. *Lancet*. 2020;395(10242):1968. doi:10.1016/S0140-6736(20)31377-5
10. UN Women. The COVID-19 pandemic has increased the care burden, but by how much? Available from: https://data.unwomen.org/features/covid-19-pandemic-has-increased-care-burden-how-much-0. Accessed December 2, 2021.
11. The state council information office, P.R.C. press conference held on situation regarding strict prevention and control of COVID-19 epidemic. Available from: http://www.gov.cn/xinwen/gwylflkjz193/index.htm. Accessed April 30, 2022.
12. Liu J, Liu M, Liang W. The dynamic COVID-zero strategy in China. *China CDC Wkly*. 2022;4:74–75. doi:10.46234/ccdcw2022.015
13. Joint prevention and control mechanism of the state council. Notice on the publication of guidelines for the implementation of regional novel coronavirus nucleic acid testing organizations (third edition). Available from: http://www.nhc.gov.cn/xcs/zhengcwj/202203/b5aaa96dfe1b4f14b19bf2f888a10673.shtml. Accessed April 30, 2022.

14. Ni P, Chen JL, Liu N. Sample size estimation for quantitative studies in nursing research. *Chin J Nurs*. 2010;45(4):378–380. doi:10.3761/j. issn.0254-1769.2010.04.037

15. Liu YL, Jin Y, Chen Q, et al. Expert consensus on hospital participation in population-wide specimen collection for COVID-19 testing. *J Nurs Sci*. 2022;37(5):1–5. doi:10.3870/j.issn.1001-4152.2022.05.001

16. Shanghai has completed 13 rounds of nucleic acid tests for more than 200 million people. Available from: https://m.gmw.cn/baijia/2022-04/17/ 1302904384.html. Accessed April 30, 2022.

17. Sharma A, Ahmad Farouk I, Lal SK. COVID-19: a review on the novel coronavirus disease evolution, transmission, detection, control and prevention. *Viruses*. 2021;13(2):202. doi:10.3390/v13020202

18. Umakanthan S, Sahu P, Ranade AV, et al. Origin, transmission, diagnosis, and management of coronavirus disease 2019 (COVID-19). *Postgrad Med J*. 2020;96:753–758. doi:10.1136/postgradmedj-2020-138234

19. Ruskin KJ, Ruskin AC, Musselman BT, et al. COVID-19, personal protective equipment, and human performance. *Anesthesiology*. 2021;134:518–525. doi:10.1097/ALN.0000000000003684

20. Centers for Disease Control and Prevention. CDC calls on Americans to wear masks to prevent COVID-19 spread. Available from: https://www. cdc.gov/media/releases/2020/p0714-americans-to-wear-masks.html. Accessed April 30, 2022.

21. World Health Organization. Coronavirus disease (COVID-19) advice for the public: when and how to use masks. Available from: https://www.who. int/emergencies/diseases/novel-coronavirus-2019/advice-for-public/when-and-how-to-use-masks. Accessed April 30, 2022.

22. Kwon JH, Burnham CD, Reske KA, et al. Assessment of healthcare worker protocol deviations and self-contamination during personal protective equipment donning and doffing. *Infect Control Hosp Epidemiol*. 2017;38(9):1077–1083. doi:10.1017/ice.2017.121

23. Kang J, Kim EJ, Choi JH, et al. Difficulties in using personal protective equipment: training experiences with the 2015 outbreak of middle east respiratory syndrome in Korea. *Am J Infect Control*. 2018;46(2):235–237. doi:10.1016/j.ajic.2017.08.04