Analysis of the Protective Effect of Infection Controllers Supervising Third-Party Personnel Entering and Leaving Shanghai Fangcang Shelter Hospital

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Objective: To analyze the impact of the new supervision and management methods of infection controllers on the protection of third-party personnel entering and leaving Shanghai Fangcang shelter hospital, to provide a reference for the management of third-party personnel in Fangcang shelter hospitals.

Methods: A total of 200 third-party personnel received with traditional supervision and management methods, and 156 received new supervision and management methods from the Fangcang shelter hospital of the Shanghai International Convention and Exhibition Center. The sociodemographic characteristics of third-party personnel, including gender, age, education level, work experience in fighting the epidemic with safety awareness, was analyzed. The effects of the two different management modes on the protection of third-party personnel were statistically analyzed by the Chi-square test or logistic regression analysis.

Results: There were statistically significant differences in the incidence of infection among third-party personnel in terms of age, education level, work experience in fighting the epidemic in traditional supervision and management group, and whether they accepted the new supervision and management model had statistically significant differences (p <0.05). The main causes of incorrect put on and take off protective clothing, such as wrong way to detach the face screen, wrong way to remove goggles, wrong way to undress protective clothing, wrong way to take off the shoe cover, hand washing steps omitted, are that causes infection of third-party personnel (p <0.05).

Conclusion: The new supervision and management model can reduce the infection rate of third-party personnel in Fangcang shelter hospitals through planned and purposeful training in terms of different age groups, education levels, work experience, and acceptance of protection knowledge.

Keywords: shelter hospital, third-party personnel, new supervision, infection rate, Fangcang hospital

Introduction

With the continuous mutation and evolution of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), a variety of mutant strains, such as Alpha, Beta, Gamma, Delta, and Omicron, have emerged.[1–6] In the COVID-19 pandemic, the Omicron virus quickly became the dominant strain, and its infection gradually showed new characteristics, including fast transmission, widespread, and strong occultation, but it also showed the characteristics of reduced pathogenicity and severe disease rate.[7–9] In the face of the novel pneumonia epidemic, the Chinese government has

established an emergency medical system for classified treatment and sent COVID-19 patients with mild or asymptomatic disease to designated quarantine centers with primary medical treatment capabilities.[8,10] Fangcang shelter hospitals have been proven to be an effective strategy for responding to the outbreak of COVID-19 in the community.[11,12] Under the condition of a shortage of medical resources, Fangcang shelter hospital of the Shanghai International Convention and Exhibition Center has adopted a new management model. Medical personnel are responsible for in-flight medical treatment, and a large amount of logistical support is handed over to third-party personnel. These third-party personnel mainly include cleaning, security, and maintenance personnel. They are responsible for the sanitation in the Fangcang shelter hospital and the transfer of the daily life necessities of the patients. Third-party personnel are not health care professionals and have never been educated or practiced in contact with infectious disease protection systems. Therefore, they have indifferent protection awareness, wear and take off protective clothing unprofessionally, have to wear protective clothing to perform a lot of manual labor and hence are more likely to be directly exposed to the source of infection. If they are infected, it will affect the livelihood of patients in Fangcang shelter hospital. So, an effective supervision and management model from medical staff is worth exploring to reduce the infection of third-party personnel.

Material
Inclusive Criteria
The third-party personnel (cleaning, security, and maintenance) from Shanghai Wanjie Company who worked in the Fangcang shelter hospital of the Shanghai International Convention and Exhibition Center from April to May 2022 were selected as the study subjects. A total of 200 third-party personnel received with traditional supervision and management methods, and 156 third-party personnel received the new supervision and management methods in May 2022. According to the requirements of minimize the infection of personnel by the health department, all of them received at least two doses of COVID-19 vaccine before entering the workforce, and the last one was given within three months. The sociodemographic characteristics of third-party personnel, including gender, age, education level, work experience in fighting the epidemic with safety awareness, was analyzed. The causes and times of errors made by third-party personnel in the process of wearing and removing protective clothing were counted.

Method
Infection Control Supervision and Management Methods
Traditional supervision and management methods as follows, the infection control supervision team is based on a shift system, and each shift sends a full-time infection control medical worker to supervise the third-party personnel out of the red zone buffer zone and guide them to put on and take off the protective equipment during the whole process. Irregularities were carefully explained. In the buffer zone, the first and second take off rooms, and finally to the clean area, there were strict inspections by infection control personnel (see Figure 1A).

The new supervision and management methods as follows, infection control medical staff should full-time supervise the third-party personnel out of the red zone buffer zone and guide them to put on and take off the protective equipment during the whole process. What's more, all third-party personnel on duty were scanned and registered, and their names, personnel categories (cleaning, security, maintenance), working hours and other related information were published and posted to facilitate subsequent epidemiological tracking (see Figure 1B). All third-party personnel protection theory training, on-site operation drills, repeated viewing of videos for consolidation, and simulation tests were added. To enter the Fangcang shelter hospital, a full score is required for the simulation. When entering the Fangcang shelter hospital, if the supervisor finds the problem of wearing and taking off protective clothing, he or she will conduct on-site correction and retraining and record the training time and improvement measures. At the same time, the cause of the error was studied by all employees. Specifically, it can be summarized as the learning-practice-examination-supervision model (see Figure 2).

Figure 1 The third-party personnel take off the protective clothing. (**A**) Using the traditional supervision and management methods; (**B**) Using the new supervision and management methods.
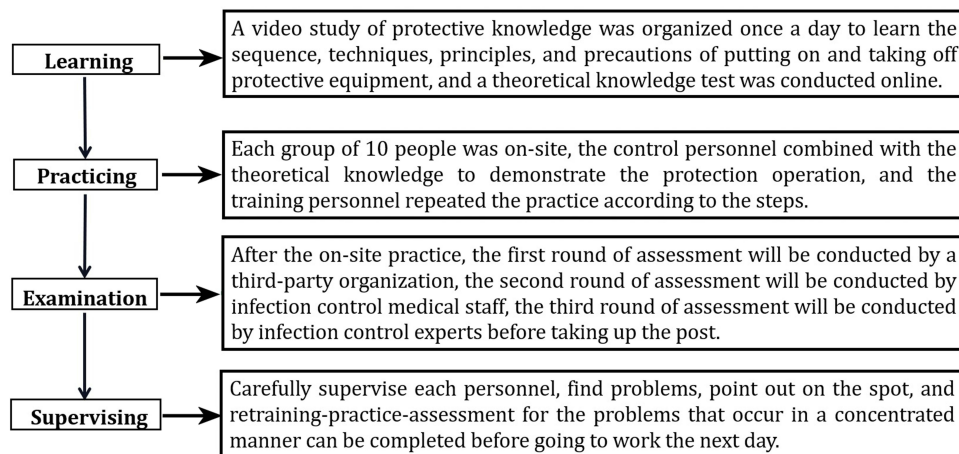

Figure 2 The process of procedures for management the third-party personnel with the new supervision and management method.

Statistical Methods

All data were processed using SPSS 22.0 statistical software. Descriptive statistical analysis was used to analyze the gender, age, education level of the third-party personnel, whether they had combined underlying diseases, vaccine injection, whether they had work experience in fighting the epidemic, and the incidence of infection. In the analysis, the comparison between groups was performed using the χ^2 test or logistic regression analysis. When $p < 0.05$, the difference was considered statistically significant.

Results

General Information of Third-Party Personnel

Among the 200 third-party personnel (cleaning, security, and maintenance), who received with traditional supervision and management methods. Cleaning in the Fangcang shelter hospital, 153 were males and 47 were females. The results showed that the third-party personnel are in terms of age, education level, and whether they have work experience in fighting the epidemic had statistically significant differences in the incidence rates (p <0.05), while the differences in the incidence of infections in terms of gender was not statistically significant (p >0.05), as shown in Table 1.

The Frequency of Errors in the Removal the Protective Equipment of Two Different Supervision and Management Methods

After implementing the new supervision and management methods, the frequency of errors in the removal of protective equipment continued to decline, and the safety awareness of third-party personnel gradually increased (Figure 3). In terms of common error removal of protective equipment, the supervision and management methods were significantly less than the traditional supervision and management methods (statistically significant), with wrong order of the face screen and the protective gown excluded.

Infection of Third-Party Personnel

During the operation stage of traditional supervision and management models, a total of 200 third-party personnel had infected 36 cases, including 32 males and 4 females. 18 cases were 18 to 30 years old, 15 cases were 31 to 40 years old, and 3 cases were over 40 years old. After the same number of days after the new supervision and management models, only 2 cases infected with the infection rate was 1.28%. The difference in the incidence of infection was statistically significant (p<0.05), see Table 2 for details.

The Main Causes of Incorrect Put on and Take off Protective Clothing That Causes Infection of Third-Party Personnel

The main causes of incorrect put on and take off protective clothing that causes infection of third-party personnel. Wrong way to detach the face screen, wrong way to remove goggles, wrong way to undress protective clothing, wrong way to take off the shoe cover, hand washing steps omitted are the main causes of incorrect put on and take off protective clothing that causes infection of third-party personnel (p <0.05), see Table 3 for details.

Table 1 Analysis of Risk Factors for Infection in Third-Party Personnel

| Factors		Number of Cases	Infection Cases	Infection Rate (%)	χ^2 value	P value
Gender	Male	153	32	20.92	3.784	0.053
	Female	47	4	8.51		
Age (years)	18–30	96	18	18.75	14.811	0.001
	31–40	59	15	25.42		
	41–50	36	0	0.00		
	>50	9	3	33.33		
Education level	University and above	48	1	2.08	35.691	<0.001
	High school level	117	17	0.00		
	Below high school level	35	18	51.43		
Whether worked in the epidemic	Yes	24	0	0.00	4.681	0.030
	No	176	36	20.45		
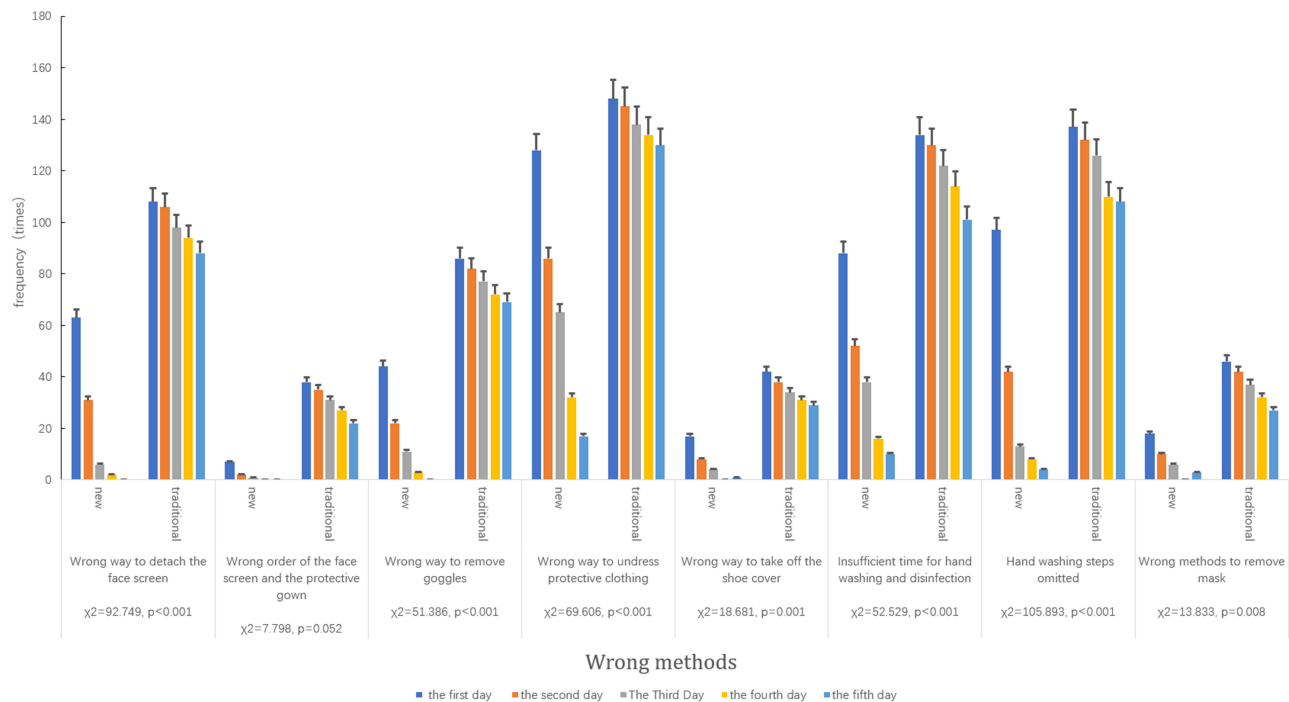
Figure 3 Comparison the errors frequency of two different methods with supervision and management of removal the protective equipment.

Discussion

Compared with the traditional supervision and management mode, the new supervision and management mode is in terms of personnel management. One infection control officer is responsible for the supervision and management of a group of full-time infection control personnel who are responsible for supervising the third-party personnel to leave the red zone buffer zone and guide them to put on and take off the protective equipment.

Table 2 Analysis of Infection of Third-Party Personnel with Different Supervision and Management Model

Supervision and Management Model	Total Cases	Number of Cases of Infection	Infection Rate (%)	χ^2 value	P value
Traditional method	200	36	18%	25.690	<0.001
New supervision method	156	2	1.28%		

Table 3 Results of Errors in the Removal of Protective Equipment with Logistic Regression Analysis with Variables in the Equation (n = 356)

Wrong Method	Sig.	Odds Ratio	95% C.I. for Exp (B)
1	0.000	0.099	0.032, 0.300
2	0.013	0.259	0.089, 0.755
3	0.014	0.087	0.013, 0.607
4	0.000	0.051	0.016, 0.163
5	0.000	0.007	0.001, 0.065
Constant	0.000	23.763	

Notes: 1=Wrong way to detach the face screen. 2=Wrong way to remove goggles. 3=Wrong way to undress protective clothing. 4=Wrong way to take off the shoe cover. 5=Hand washing steps omitted.

Therefore, it avoids the situation that in the traditional model, the personnel are scattered, and the problems that cannot be solved on duty are not implemented. Develop a roster of all personnel to go to work, check in with real names according to the shift, and check the health code to ensure that all personnel entering and leaving the passageway of the wear and tear area are safe and controllable personnel and to avoid the entry and exit of other factories and halls that bring bacteria and viruses in. In terms of training management, this mode targeted training based on the basic situation of third-party personnel. After multiple multistep training sessions, the frequency of third-party personnel taking off the protective equipment gradually decreased, and safety awareness gradually increased. In terms of quality control management, continuous improvement measures are proposed for problems, and continuous improvement is implemented to form a virtuous circle.[13–15] In terms of effective communication, to ensure that all communication can be fed back to the people for the first time, the reported problems are solved in a timely manner.

The new type of supervision and management model provides purposeful and planned training based on the age, education level of third-party personnel, and whether they have work experience in fighting the epidemic that is statistically significant in reducing the number of infections and intervenes and evaluates existing problems at any time. Improved effectiveness and timely adjustment of training programs ultimately increased safety awareness and reduced the rate of infections, which greatly reduced the infection rate of third-party personnel in shelter hospitals.[16]

The age of the third-party personnel had statistical significance in reducing the rate of infections. This suggests that younger people are more likely to learn and accept the complex and professional work of putting on and taking off protective equipment.[17–19] Besides, the undressing process needs to be completed independently and is prone to errors. Young people are willing to admit mistakes, accept criticism and help from the supervision and management from medical staff, and they are more willing to communicate with others to learn and improve together.

The education level of third-party personnel was statistically significant in reducing the number of infections. In this epidemic, the COVID-19 virus was extremely contagious. We should fully study its biological characteristics to be better protected ourself at work. Even the training content is limited to the steps of the process of putting on and taking off protective equipment, personnel with a high level of education can combine theoretical knowledge and practice to master the specific steps of putting on and taking off masks, protective clothing, goggles, and visors.[20,21] Highly educated personnel are better able to understand the significance of each step of putting on and taking off protective clothing, and better understand the consequences of putting on and taking off protective clothing incorrectly. As a result, they are better able to prevent mistakes from happening, and better able to accept with remedial measures after mistakes. Although third-party personnel do clean and security work, the risk factors are higher. Therefore, it is recommended that third-party personnel try to recruit personnel with higher education levels. The higher the overall education level is, the lower the risk of infection.

Third-party personnel with work experience fighting the epidemic had statistical significance in reducing the number of infections. Possessing work experience in fighting the epidemic has important guiding significance for this type of epidemic work.[22,23] Protection is the key point in the work of the epidemic. The personnel with such work experience pay more attention to the details of protection when wearing protective equipment than other personnel when performing hygiene, such as avoiding pollution. It can prevent sharp objects from scratching the gloves, and the mask needs to be replaced urgently after sweating so that it can respond urgently and have a stronger awareness of safety protection.[24] At the same time, serving as the monitor and group leader in the team, dispersed in each group. Entering and exiting the Fangcang shelter hospital at the same time as other third-party personnel can guide and help the colleagues around him at any time, improve the overall protection level, and reduce the rate of infections.

Putting on and taking off protective clothing is a very professional working for medical staff, who are often not standardized in this daily work.[2,24–27] It is even more difficult for non-professional third-party personnel. Third-party personnel not only need to face COVID-19 patients, but also need to handle the extremely high amount SARS-CoV-2 of medical waste.[28] This study preliminarily discussed how to guide the third-party

personnel in Fangcang shelter hospitals to wear and remove protective clothing. The main causes of incorrect put on and take off protective clothing, such as wrong way to detach the face screen, wrong way to remove goggles, wrong way to undress protective clothing, wrong way to take off the shoe cover, hand washing steps omitted, are that causes infection of third-party personnel. So, these errors need to strengthen the correction.

As the first study to raise this issue, it also has some limitations and shortcomings. Firstly, this study is a retrospective study with small sample size, which may have statistical bias. Secondly, the two different supervision and management methods are carried out in different periods of time, which may be interfered by other hidden factors, such as the latter may obtain more learning opportunities for epidemic prevention knowledge. However, we believe that this study can bring some enlightenment to the anti-epidemic work. Firstly, the anti-epidemic work can give full play to the strength of third-party personnel and reduce the pressure on medical resources. Secondly, reasonable supervision and management methods can reduce the infection rate of non-medical staff in high-infection wards. Thirdly, this study provides some effective measures to guide non-medical staff to wear and remove protective clothing.

Conclusion

The main causes of incorrect put on and take off protective clothing, such as wrong way to detach the face screen, wrong way to remove goggles, wrong way to undress protective clothing, wrong way to take off the shoe cover, hand washing steps omitted, are that causes infection of third-party personnel. The new supervision and management methods are more comprehensive and meticulous in personnel management, training management, and quality management than the traditional management model. This greatly reduces the number of third-party personnel infected and reduces the infection rate of third-party personnel in shelter hospitals. Compared with the traditional supervision and management methods, it is more suitable for the protection and management of third-party personnel in Fangcang shelter hospital, which is worthy of recommendation. We hope that by spreading this experience, more people will be able to participate in the fight against COVID-19 without becoming susceptible to infection.

Ethics Statement

This study complies with the guidelines for public studies and is in accordance with the Declaration of Helsinki. Written informed consent was obtained from the patients and/or the public in accordance with the Declaration of Helsinki for the purpose of publication of the present report and any relevant images. This is a public health management experience report; thus, no medical ethics statement is needed according the Ethics Review Committee of General Hospital of Central Theater Command of the Chinese People's Liberation Army.

Patient and Public Involvement

Patients and/or the public were not involved in the design, conduct, reporting, or dissemination plans of this research.

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.

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Disclosure

The authors report no conflicts of interest in this work.

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