

“Five Firewalls” Management Against COVID-19 for the Residents in Dormitory in Shanghai

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Abstract: *Objective:* Study the epidemic prevention management of COVID-19 for the residents in dormitory, to protect them from infection to the greatest extent. Explore effective management methods in the case of high mobility and dense accommodation. *Methods:* The root cause analysis method (Ishikawa causal analysis method) was used to analyze the management status and main problems at the early stage of the epidemic from the four aspects of personnel, materials, systems and the environment. Combined with the development of the epidemic situation and policy adjusting, Shanghai East Hospital has adopted the “five firewalls” strategies to gradually strengthened the dormitory management for residents in five aspects. *Results:* After 6 months of management practice, the infection rate of COVID-19 among the residents of the hospital was 0% (0/287), and the infection rate among the residents in dormitory was 0% (0/103). At the same time, the results of the questionnaire survey by the residents indicated that the satisfaction with the epidemic prevention management strategies of the dormitory building reached 98.99% (98/99). *Conclusion:* The “five firewalls” management strategies played an active role in the epidemic prevention management for the residents in concentrated accommodation. For centralized accommodation management in a complex epidemic situation, it is very important to timely grasp the personnel physical condition and movement information, and prevent the input of the epidemic from the source; The residents-led management model can reduce the pressure on the management departments and has good results.

Keywords: Residents, Dormitory Management, Epidemic Prevention, Five Firewalls Management Strategies

1. Background

Since December 2019, multiple cases of COVID-19 have been found in Wuhan City, Hubei Province, China [1]. With the spread of the epidemic, Wuhan announced the lockdown of the city on January 23, 2020, and the lockdown of whole Hubei province on January 25. Soon after, there were more than 10,000 confirmed cases nationwide at the end of January. On January 30, the World Health Organization (WHO) declared the outbreak of COVID-19 as a Public Health Emergency of International Concern (PHEIC) [2]. By 6 December 2020, there had been 65,870,030 confirmed cases of COVID-19, including 1,523,583 deaths, reported to WHO globally [3]. And these numbers are still growing rapidly.

The globalized epidemic has brought unprecedented severe challenges to the management of residency standardized training in China and other countries.

In response to the epidemic, Chinese hospitals have adopted a series of measures to adjust the training and management for residents in terms of improving the resident management systems, implementing personnel classification management, and giving lectures on epidemic prevention and control [4, 5]. Some training bases enriched teaching methods and used the “Internet + Education” teaching method to undertake the traditional offline lectures, which ensure the smooth progress of the residency training during the epidemic [6]. The special studies on the mental health of residents during the epidemic have also been conducted. The results show that residents’ exposure risk, learning ability, and public opinion environment will affect the

mental health of residents during COVID-19 [7, 8].

In other countries, residents have also dealt with numerous challenges and changes during this pandemic [9]. It is clear that, at least during the remainder of the 2019–2020 academic year, most residents and fellows will not be able to accomplish clinical rotations, operative case log minima, and nonoperative patient care encounters as set forth in the requirements for program accreditation. Therefore, alteration in activities was conducted to meet Accreditation Council for Graduate Medical Education (ACGME) program requirements [10]. As of April 1, 2020, all programs had begun to use videoconferencing in urology residency programs and the majority planned to continue in America [11]. In Italy, to address the challenge of a decline in clinical opportunities, strategies aiming to increase the use of telemedicine, "smart learning" programs and tele-mentoring of surgical procedures, are warranted [12].

This international medical crisis has the potential to significantly alter the course of training for our current resident cohort. It is important that we closely monitor the impact of this pandemic on resident education and ensure the implementation of alternative learning strategies while maintaining an emphasis on safety and well-being [13, 14]. Personal safety, mental health and basic living supports of residents should always be the first priority. However, the related research during COVID-19 is not sufficient.

In 2014, the Chinese residency standardized training was officially launched nationwide [15]. Shanghai East Hospital Affiliated to Tongji University became the first training bases, accepting residents from all over the country. The hospital rent a dormitory building in Tongji University to provide accommodation for residents, and committed to ensuring their health and safety and providing them with good working and living environment. This study will share the epidemic prevention management experience against COVID-19 for the residents in dormitory, and provide reference for later research and residency training management.

2. Situation Analysis

Using the root cause analysis method, the situation and main problems at the early stage of the epidemic are analyzed from the four aspects of human, material, system and environment as followed.

2.1. Human Factors

January 24-30, 2020 is China's Lunar Year Spring Festival, and about 75% of the residents in Shanghai East Hospital left Shanghai to return hometown for the holidays. During this period, the personnel movement was uncertain and complicated.

2.2. Material Factors

The spread of the epidemic has led to a huge demand of

anti-epidemic materials across the country. Medical masks, gloves, hats, protective clothing, goggles, alcohol, disinfectant and other anti-epidemic materials are in short supply.

2.3. Institutional Factors

At the beginning of the outbreak, there were no mature prevention management system for residents from community, hospital or university respectively. Residents administrators could only practice and explore based on the superior prevention and control policies in combination with the actual situation.

2.4. Environmental Factors

The environment where residents related was complex and high-risk, including working place, public transportation, and living environment etc. Especially in the dormitory building where residents live intensively. The existing epidemic prevention measures were inadequate and there were a lot of administrative pipeline (they were under the jurisdiction of the university, the hospital and the local community separately).

In summary, during the early stage of the epidemic period, the problems such as high mobility, dense accommodation, lack of epidemic prevention materials and mature prevention system, multiple management departments, and high-risk work and living environment have showed up. Therefore, it is urgent to explore effective prevention management strategies especially for the residents in dormitory.

3. Methods

Facing with the complex situations, the Teaching and Training Department of the hospital has adopted gradual tightening management methods, combined with the development of the epidemic situation and the dynamic changes of local policies, explored a set of "five firewalls" epidemic prevention strategies for the residents in dormitory.

3.1. The First Firewall: Use Online Registration to Comprehensively Track Physical Conditions and Personnel Movements of the Residents

Since the outbreak of the epidemic in January, the Teaching and Training Department has used an online questionnaire to conduct daily physical condition and movement surveys of all 287 residents. The residents returning to Shanghai from other provinces were required to be quarantined for 14 days on their own. Those keeping well were allowed to return to the hospital for work.

At the end of January, there were 205 residents in Shanghai, of which 103 living in the dormitory building of Tongji University (Dormitory No. 8 of Huxi Campus). Following the *Table 1* for the personnel in the building.

Table 1. Status of the Residents in the Dormitory No. 8 of Huxi Campus of Tongji University (by January 31, 2020).

Content	Total occupancy	Not leaving Shanghai	From other provinces return to Shanghai	From High-risk regions return to Shanghai	From Non-High-risk regions return to Shanghai
Numbers of People	103	34	69	4	65

3.2. The Second Firewall: Strict Nucleic Acid Testing for the Residents Returning to Shanghai from Other Provinces

After March 31, 2020, the virus detection kits were ready. The residents returning to Shanghai from other provinces will take nucleic acid testing (Figure 1), blood and virus antibody testing. And they could return to dorm and work only after the test results are negative, which could prevent the import of the epidemic from the source.



Figure 1. Resident From Other Provinces Returning to Shanghai Is Taking Viral Nucleic Acid Testing.

3.3. The Third Firewall: Establish a Cross-unit Management Team, Formulate Emergency Plans, and Smooth Communication Channels

In order to improve the management efficiency, Shanghai East Hospital, Tongji University, Putuo Community united to organize a temporary emergency management team to form a cross-unit collaborative management system. They formulated dormitory building management measures and emergency response plans during the epidemic, and implemented measures such as a temporary campus pass, accommodation personnel information registration and tripartite joint inspection, etc. At the same time, an online contact group was established to provide real-time feedback and solve dormitory management problems.

3.4. The Fourth Firewall: Implement a Point-to-point Responsibility System and a Special Resettlement for the Residents from the High-risk Regions

A point-to-point responsibility system of the dormitory buildings was built, which means the hospital should be responsible for its own dormitory building. Since February, 2 residents shared one room in the dormitory No. 8, and the Teaching and Training Department dispatched special staffs to guard the dormitory No. 8 for 24 hours a day. Temperature measuring and registration were required for entry and exit. The administrators of the Teaching and Training Department conducted daily inspections to check the residents.

The residents returning from the high-risk regions were individually resettled. On February 5, four residents from HuBei Province were assigned to another building dedicated to isolation for 14 days of medical observation in a single room with meals and essential supplies. Their body temperature was monitored twice daily. Once fever or other symptoms were detected, according to emergency plan, they will be sent to hospital for medical examination.

3.5. The Fifth Firewall: Implement a Residents-led Management Model of the Dormitory Building

Long-term and high-intensity management has greatly tested the human and material resources of the management department, and it has also brought tremendous pressure to the resident physicians' physiology and psychology. The Teaching and Training Department has tried the residents-led management model, from the aspects of material, system, behavior and spiritual culture.

3.5.1. Interim Self-government Committee

On February 8, the Teaching and Training Department set up the Interim Self-government Committee of residents in the dormitory No. 8 urgently. The administrator of the department served as the chairman and committee members were elected through self-recommendation. The residents-led management mechanism was established under the leadership of the Committee. The management architecture is shown as follow (Figure 2).

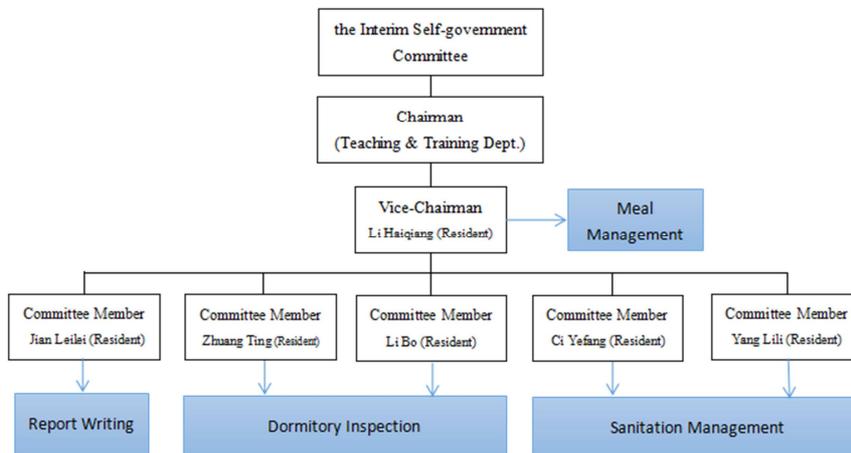


Figure 2. The Structure of the Interim Self-management Committee of the Dormitory No. 8.

3.5.2. Dormitory Management

- a) Objective: During the COVID-19 pandemic, the residents in the dormitory building have zero infection; And help them go through the epidemic period safely and orderly.
- b) System: The committee discussed and established a series of management measures through online meeting, including the daily regular meeting system and various measures such as dining, dormitory inspection and disinfection. Every committee member had a clear work assignment and responsibility, and kept a positive working attitude.
- c) Spiritual Culture: The self-government model can more easily obtain the understanding and cooperation of the residents in the building, stimulate their enthusiasm to participate in the management of the dormitory. There by creating a good atmosphere, avoiding panic, stabilizing mood and overcoming the difficulties.
- d) Material support: The epidemic prevention materials in the dormitory No. 8 are extremely scarce at the beginning. The committee won one disposable medical mask per person per day from the hospital, as well as some medical hats, protective gloves, disinfectants, alcohol and other protective equipment. The university agreed to provide cleaning personnel and equipment, etc.
- e) Meal Management: Considering the risk of centralized meals in the school cafeteria, the committee was responsible for ordering the meals and set up a delivery team to deliver and distributed meals, ensuring the dining needs of the residents.
- f) Dormitory inspection system: The committee

implemented dormitory inspection measures, including routine dormitory inspection (9:00 and 20:00) twice a day and random inspection. The leaders of each floor will lead the volunteers in the building to complete the routine dormitory inspection, including body temperature monitoring, room hygienic inspection and humanistic care (Figure 3). The committee inspected randomly. The summary as follow (Table 2).



Figure 3. The Routine Dormitory Inspection (Body Temperature Monitoring).

Table 2. Summary of Dormitory Inspection Situation of Residents in the Dormitory No. 8 of Huxi Campus.

Date: February 9			Body Temperature		Sanitary Condition of the Dorm		Humanistic Care	
Serial Number	Room Number	Name	9:00	20:00	Excellent/Good /General/Poor	Illegal appliances	Is there any discomfort?	Something to Feedback
1		Resident A	36.8	36.6	Good	No	No	No
2	114	Resident B						
3		Resident C						

- g) Sanitation Management: Good hygiene management is an effective means to prevent infections in the building. The committee started with the following four aspects.

Sanitation inside the room: the residents are responsible for cleaning of their own rooms, daily inspected.

Sanitation in public areas: the cleaning staff cleans and disinfects twice a day, windows are opened for ventilation for at least one hour per day.

Centralized garbage disposal: Since the garbage throwing point is located outside the dormitory building, the committee set a fixed period of time to open garbage disposal (19: 00-19: 30), and volunteers took turns to supervise daily.

Personal health: Once leaving the room, the residents must put on their masks, no in-person gatherings, and maintain a social distance of at least 1 meter.

4. Results

4.1. Health Condition

From January 26 to March 31, 2020, 287 residents in training were investigated daily for their track, location and health status. The total investigations number of personnel track was 18942 and of personal health was 18942. 4 cases of abnormal temperature and 272 reports of discomfort were found out. All of them had been ruled out for the COVID-19 infection in hospital.

After March 31, 2020, the hospital conducted concentrated nucleic acid testing, blood and virus antibody testing on 67 residents who returned to Shanghai from other provinces, and the results were all negative. As of July 31, the infection rate of all 287 residents of Shanghai East Hospital was 0% (0/287),

so the goal of zero infection prevention and control was achieved.

4.2. Accommodation Management

From January to July, the infection rate of the residents in dormitory was also 0% (0/103). This was a milestone for centralized accommodation management for residents. In order to continuously studying the effectiveness of the residents-led management model, the Teaching and Training Department used a questionnaire survey to investigate the residents' experience. The investigation involved 99 residents in the dormitory No. 8 (except for the four residents from high-risk regions in separate isolation), the details as follows.

4.2.1. Degree of Participation in Dormitory Management

During the residents-led management of the dormitory No. 8, there were 30 residents participating in the management of various work of the dormitory, accounting for 30.3% of total, nearly reached one third. The number of participants in the three main tasks of the management were: 8 persons for meal management (ordering and delivering meals), 22 persons for dormitory inspection (temperature monitoring, checking dormitory circumstance), and 8 persons for sanitation management (Centralized garbage disposal duty, cleaning inspection of public areas). All showed a relatively good degree of management participation.

A survey of the willingness to participate in dormitory management in the future showed that 57 persons expressed their willingness to participate, accounting for 57.58% of total. More people were willing to participate indicating that the residents-led management model has promoted the enthusiasm of residents at a certain extent.

4.2.2. Overall Satisfaction

The overall satisfaction survey results for this management work showed that a total of 98 persons selected “Very Satisfied” and “Satisfied”, reached 98.99% (98/99), as shown in Figure 4. The data shows that the work of the interim self-management committee has been widely recognized and met residents’ expectation.

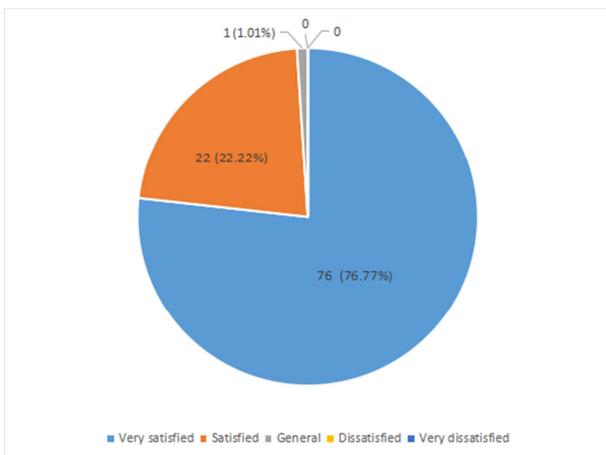


Figure 4. The Overall Satisfaction of Residents-led Management of the Dormitory No. 8.

At the same time, the satisfaction of the residents-led management model also reached 98.99% (98/99). This data showed that residents generally deemed the effectiveness of the model and has a very high degree of acceptance of it. Since then, the exploration of the residents-led management model for the residents in dormitory has achieved a success.

4.2.3. The Satisfaction of Three Major Tasks

In addition to overall satisfaction, an additional survey was conducted on the three tasks, including meal, dormitory inspection and sanitation, as shown in Figure 5.

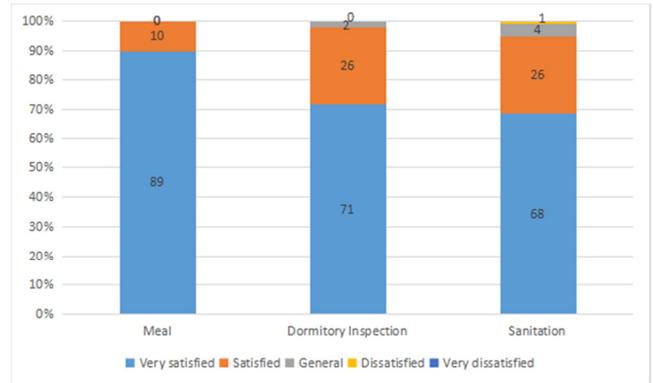


Figure 5. The Satisfaction of Main Jobs During Residents-led Management of the Dormitory No. 8.

In the survey on meal management, satisfaction reached 100% (99/99), of which 89 persons chose “Very Satisfied”. Residents made evaluations on ordering, meal delivery, meal quality, etc. The overall satisfaction is 100%, meal order is 100%, meal delivery is 100%, and meal quality is 97%.

In the survey on dormitory inspection management, satisfaction reached 97.98% (97/99). The residents showed an identity to affirm the necessity of the dormitory inspection system twice a day, and at the same time, they also put forward suggestions. The main feedback was that the infrared forehead thermometer used to measure body temperature had a high failure rate, and it was recommended to be replaced by an ear thermometer.

In the survey on health management, satisfaction reached 94.95% (94/99). Among them, the sanitation in public areas satisfaction is 91.92% (91/99), the centralized garbage disposal satisfaction is 100% (99/99), and the dormitory hygiene supervision work satisfaction is 97.98% (97/99). The problems in the investigation mainly focused on the sanitation and disinfection of public areas, which have been communicated with the university dormitory management department and could be solved soon.

5. Conclusion

Since the outbreak of the COVID-19 in Shanghai in January 2020, facing with the problems such as high mobility, dense accommodation, lack of epidemic prevention materials and mature prevention system, multiple management departments, and high-risk work and living environment, the Teaching and Training Department of Shanghai East Hospital gradually

explored a set of "five firewalls" anti-epidemic management strategies for the residents in dormitory : Use online registration to comprehensively track physical conditions and personnel movements of the residents; Strict nucleic acid testing for the residents returning to Shanghai from other provinces; The hospital, the university, and the local community work together to establish a cross-unit management team, formulate emergency plans, and smooth communication channels; Implement a point-to-point responsibility system of the dormitory buildings, and the residents returning to Shanghai from the high-risk regions are individually resettled; Implement a residents-led management model of the dormitory building to comprehensively guaranteed their safety.

After 6 months of management practice, the infection rate of COVID-19 among the residents of Shanghai East Hospital was 0% (0/287), and the infection rate among the residents in dormitory was 0% (0/103) as well. Moreover, the satisfaction of the residents-led management of the dormitory building reached 98.99% (98/99).

It has proved that the "five firewalls" strategies are effective, and the management goal of zero infection of residents is successfully achieved.

The success of this strategy provides some empirical reference for the management in the case of high mobility and dense accommodation: It is very important to timely grasp the physical condition and movement information of the personnel, and prevent the input of the epidemic from the source.

The innovative model of residents-led management has also achieved satisfactory phased results. Under the epidemic situation, the residents in the building have a very high degree of acceptance of the self-government model, and with good cooperation. At the same time, it has fully motivated the enthusiasm of the residents, which is also helpful to reduce the pressure of the management department.

6. Prospect

At present, the global epidemic haven't seen its end, and no one can stay out of it. We must not let the guard down, and still need to continuously fight back, and steady the "five firewalls". On the basis of ensuring the personal safety of residents and safeguarding their basic human rights, according to the development of the epidemic situation and the dynamic changes of national policies, we will continue to improve the management system and strategies of disease prevention for residents, actively explore and innovate the effective mode for residents in special periods.

Residents are playing an important role in this battle. The Teaching and Training Department should always committed to ensure the physical and mental health and basic rights of residents, and strive to provide them with support, helping them grow into a qualified clinician. It's necessary to assist the residents fighting on the front line against the COVID-19, to gather and develop additional resources to support and fully cooperate with the 'soldiers' to win this epidemic prevention battle [16, 17].

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Competing Interests

The authors declare that they have no competing interests.

Contributions

Chen Chi, and Sun Xiaoliang had the idea for the article. Chen Chi, Sun Xiaoliang, Kang Baoli, Ding Min, Luo Xi implemented the epidemic management for the residents and collected data. Sun Xiaoliang wrote the first draft and all the authors contributed to the final draft.

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