An Exploratory Analysis of Ward Operation Models and Spatial Nursing Management Practices in Fangcang Hospitals During Public Health Emergencies

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Abstract

Objective To explore the operational model and spatial nursing management of cabin hospital wards in public health emergencies. Methods A cabin hospital ward for public health emergencies was constructed, and a 24-hour ward nursing operation model was established. Based on the disease characteristics of cabin hospitals and public health emergencies, spatial management theory was introduced, safety hazards were systematically reviewed, and nursing risk management was implemented. Nursing quality-related indicators before and after implementation were evaluated. Results Following the implementation of spatial nursing management in cabin hospital wards for public health emergencies, the nursing work defect rate and adverse reaction incidence rate decreased, while nursing work quality improved ($P < 0.01$). Conclusion The establishment of cabin hospital wards is feasible and practical. Integrating spatial management into nursing risk management is positive and effective, facilitating the allocation of various resources under sudden epidemic conditions and enhancing nursing work quality.

Full Text

Analysis of Ward Operation Mode and Spatial Nursing Management Practice in Makeshift Hospitals During Public Health Emergencies

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Abstract

Objective: To explore the ward operation mode and spatial nursing management in makeshift hospitals during public health emergencies. **Methods:** We established makeshift hospital wards for public health emergencies, constructed a 24-hour ward nursing operation model, and introduced spatial management theory tailored to the disease characteristics of makeshift hospitals and public health emergencies. We identified safety hazards and implemented nursing risk management, evaluating nursing quality indicators before and after implementation. **Results:** After implementing spatial nursing management in the makeshift hospital ward, the nursing work defect rate and adverse event incidence decreased, while nursing work quality improved ($P < 0.01$). **Conclusion:** Establishing makeshift hospital wards is feasible. Integrating spatial management into nursing risk management is proactive and effective, facilitating resource allocation during emergent outbreaks and improving nursing work quality.

Keywords: makeshift hospital; spatial management; nursing risk; public health emergencies

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Introduction

Coronavirus disease 2019 (COVID-19) has spread globally. Due to its extremely high transmissibility, the WHO classified COVID-19 as an "international public health emergency of concern" [1]. By late February 2022, the outbreak in Shanghai had erupted, with the vast majority of cases caused by the Omicron BA.2 and BA.2.2 variants [2]. As the number of confirmed COVID-19 cases rose sharply, the Shanghai Lingang Makeshift Hospital was activated to alleviate hospital bed shortages. Jointly established by the Huashan Hospital affiliated with Fudan University and medical teams from Jiangsu, Zhejiang, Henan, Shanxi, and Guizhou, the facility provided large-capacity, low-cost medical beds to centrally treat mild COVID-19 cases. As one of the largest converted makeshift hospitals in China, Shanghai Lingang Makeshift Hospital treated a cumulative

total of 47,224 patients from its activation on April 5, 2022, to its closure on May 20, 2022. Many practical experiences from Shanghai Lingang Makeshift Hospital have been successfully transformed into municipal standards and specifications, providing valuable references for the operation of ultra-large makeshift hospitals [3].

The concept of spatial management [4] refers to the efficient and economical utilization of organizational space in facility management. Through rational arrangement and integration of human resources, materials, technology, and processes, optimal utilization efficiency is achieved. The most critical aspect of spatial management is spatial control to improve work efficiency and quality.

As the team leader of the Jiangsu medical aid contingent to Shanghai, the author introduced spatial management concepts into daily nursing management in the makeshift hospital, summarizing a practical and effective set of nursing quality management experiences that enhanced nursing safety. This report presents these findings.

Methods

1.1 General Information Shanghai Lingang Makeshift Hospital was converted from a 150,000-square-meter storage facility through an eight-day, eight-night effort by Lingang Group, China Construction Eighth Engineering Division, Huajian Group, and Shanghai Construction Group [5]. The hospital was jointly managed by the Huashan Hospital medical team and medical aid teams from Jiangsu, Zhejiang, Henan, Shanxi, and Guizhou. The Jiangsu medical aid contingent comprised teams from provincial hospitals, Wuxi, Zhenjiang, Suzhou, and Nantong. The author's unit served as one sub-team within the provincial hospital team.

At the initial activation of Shanghai Lingang Makeshift Hospital, the author's medical unit, together with another provincial hospital team and a municipal hospital team, jointly established and managed a ward area with 640 beds. On April 20, 2022, Lingang Makeshift Hospital underwent upgrading and personnel reorganization. From April 21 to May 7, the author's medical unit took over another ward area with 164 beds as a complete unit. As an independent ward unit in the makeshift hospital, the facility implemented a responsibility system of holistic nursing ward management led by a medical team leader and a nursing cabin leader. The staffing included 6 doctors, 30 nurses, 4 logistics workers, 1 external transport worker, 2 security personnel, and 1 other staff member, all managed through 24-hour rotating shifts.

1.2 Nursing Staff Structure The nursing team comprised 30 individuals, 28 of whom had experience with foreign medical aid teams. All were female, with an average age of 34.60$±$4.26 years. The professional structure included 1 senior-level nurse (3%), 17 intermediate-level nurses (57%), and 12 junior-level

nurses (40%). Departmental backgrounds included 2 from critical care units (7%), 3 from respiratory departments (10%), 24 from general wards (80%), and 1 from outpatient services (3%).

1.3 Management Personnel Setup The ward area was under the vertical leadership of the Joint Nursing Department of the makeshift hospital. The ward had a total of 9 nursing management personnel, including 1 cabin head nurse and 1 nursing cabin leader.

1.4 Staffing and Scheduling Following national nursing human resource allocation principles for makeshift hospitals, the ratio of total beds to frontline nursing staff was 1.00:0.51 [6]. The scheduling system consisted of 6 shifts, each averaging 4 hours: A shift (7:00-11:00), middle shift (11:00-15:00), P shift (15:00-19:00), evening shift (19:00-23:00), N shift (23:00-3:00), and early shift (3:00-7:00). Human resource allocation for each shift is shown in Table 1 .

2.2 Ward Operation Mode The ward primarily admitted asymptomatic and mild COVID-19 patients. For each admission, the ward received advance notice from the command center. The attending physician and triage nurse would meet the transport driver at the patient entrance. After the physician assessed that the patient met admission criteria, male and female patients were sorted into two separate lines. The triage nurse affixed ward and bed number stickers to the outer upper side of the patient's right lower limb. Guide nurses arranged for patients to enter the cabin in an orderly manner. Upon reaching the designated area, handover with the responsible nurse was completed. The responsible nurse assisted patients with scanning QR codes for registration, obtaining bed codes, and confirming final bed assignments. Office nurses confirmed information in the computer system and printed wristbands. Responsible nurses verified patient information, assisted with wristband wearing, and guided patients in reading admission manuals and health education materials.

During their stay, attending physicians and nursing cabin leaders conducted daily rounds. Patients received various treatments (including blood pressure, blood glucose, pulse oximetry monitoring, and blood draws). Discharge criteria included: (1) consecutive negative nucleic acid reports for two days (with intervals over 24 hours); (2) double gene CT values >35; and (3) no obvious clinical symptoms or fever [7]. Attending physicians issued discharge orders one day before discharge. On the discharge day, nurses assisted patients with personal item disinfection and discharge procedures. Nurses escorted patients to the exit, where specialized transport vehicles delivered them to their residential communities for home isolation. Nurses performed terminal disinfection of bed units.

2.3.1 Effective Area Division and High-Risk Monitoring Point Designation The ward area had a rectangular frame shape. Doctor and nurse

workstations, treatment rooms, emergency rooms, storage rooms, and disposal rooms were arranged in a linear configuration along the long wall side, with the remaining area designated for patient rooms. The author divided the ward area, selecting the area closest to the nurse station and patient entrance as the high-risk zone to facilitate patient monitoring and critical patient transfer (see Figure 1 [Figure 1: see original paper]).

2.2.2 Innovation of Nursing Guide Post and Position-Based Scheduling The nursing guide post is a novel nursing position created during the COVID-19 outbreak to address the centralized admission of large patient volumes in makeshift hospitals. This position is staffed by personnel with nursing experience. Responsibilities include guiding batch patient admissions to ensure orderly entry, conducting epidemiological investigations of newly admitted patients, understanding patients' underlying conditions, and observing patients during the admission process. Scheduling requirements: (1) Determine the number of posts based on transport vehicle routes and ward area size; (2) Maintain appropriate distance between adjacent guide posts while ensuring interaction; (3) This is a flexible nursing position activated only during large-volume admissions following elastic scheduling principles (see Figure 2 [Figure 2: see original paper]).

2.2.3 "C-Position" Management of Warehouse Shelves to Improve Material Access Efficiency Ward material management is a critical factor in ensuring nursing safety. The emergency item management system emphasizes "fixed quantity, fixed location, fixed personnel responsibility, and regular inspection." Building upon this, the "fixed location" principle was enhanced with "C-position" management: based on average nursing staff height, the area 120-140cm from the ground and directly facing the storage room door was designated as the prime shelf area for storing emergency equipment and supplies.

Figure 3 [Figure 3: see original paper] illustrates the "C-position" management of warehouse shelves.

2.2.4 Design of Emergency Cart Internal Structure Diagram to Create Spatial Order for Treatment Items Following requirements for emergency cart item placement, an internal item placement structure diagram was created and posted on the emergency cart surface. The first drawer stores sterile items (indwelling needles, dressings, infusion stickers, infusion sets, blood collection needles, scalp needles, cotton swabs, etc.). The second drawer stores various emergency medications. The third drawer stores various syringes. The fourth drawer stores simple respirators, oxygen tubes, gloves, etc. (see Figure 4 [Figure 4: see original paper]).

2.2.5 Integration of Spatial Position Management in Patient Transfer to Implement Fixed Personnel and Responsibilities When patients

required condition changes and transfer to other hospitals, a transport team was assembled to move patients from the cabin ward to the ambulance: (1) Personnel: 1-2 nurses and external transport staff; (2) Equipment: dedicated patient transport bed with bedding, and if necessary, an emergency nursing box containing oxygen pillow, simple respirator, mouth opener, skin disinfectant, cotton swabs, 22-24G indwelling needle, 250mL normal saline, and epinephrine (1mg × 1); (3) Nursing staff positions and responsibilities: The nurse stands at the patient's head side (for severely ill patients, two nurses may be assigned: Nurse 1 at the head side, Nurse 2 at the left side or the side with intravenous access), confirming that bed rails are raised and chest restraints are secured, ensuring patient warmth. If intravenous therapy is ongoing, ensure the IV line is patent and secure. Monitor patient facial expressions and provide emotional support. External transport staff stands at the foot side, confirming the emergency nursing box and patient medical records are secured to prevent damage during transport. Nurses and transport staff jointly push the transport bed to ensure patient safety during transport.

2.2.6 "Rolling-Shutter" Disposal Method for Innovative Spatial Volume Management to Reduce Aerosol Transmission Risk Terminal processing of bed units after patient discharge or transfer presents challenges. Conventional bed linen removal increases viral density in the surrounding environment, thereby increasing aerosol transmission risk. The author's approach involves using a "rolling-shutter" technique to remove used bed sheets and covers, then rolling up the quilt core using the same method before implementing ultraviolet disinfection.

2.3 Effect Evaluation We compared nursing work defects, adverse event incidence rates, and nursing work quality before implementation (April 5-20, 2022) and after implementation (April 21-May 7, 2022).

2.3.1 Nursing Work Defects and Adverse Event Incidence Rates Based on daily work logs from our medical team and daily nursing quality analyses from nursing cabin leaders, we counted cases of nursing work defects and adverse events to calculate defect rates.

2.3.2 Nursing Work Quality A self-designed scale was used, including six items: admission nursing, communication skills, basic operations, medication nursing, transfer nursing, and health education. Each item used a 5-point Likert scale, scored from 1 (very dissatisfied) to 5 (very satisfied), with higher scores indicating better nursing work quality.

2.4 Statistical Methods Data were analyzed using SPSS 19.0 statistical software. Count data were described as frequencies and percentages, with inter-group comparisons using X^2 tests. Measurement data were described as means and standard deviations, with inter-group comparisons using t-tests.

Results

3.1 Nursing Work Defect Rate Reduction (see Table 2) Table 2 compares nursing work defect rates before and after implementation (%): Admission nursing defects decreased from 45 (9.57%) to 9 (1.90%); verification defects from 10 (2.12%) to 12 (2.55%); operation defects from 1 (0.21%) to 5 (1.05%); medication defects from 5 (1.06%) to 1 (0.21%); emergency defects from 1 (0.21%) to 20 (4.26%); discharge nursing defects from 8 (1.69%) to 92 (19.57%); total defects from 25 (5.27%) to <0.001.

3.2 Nursing Adverse Event Rate Reduction (see Table 3) Table 3 compares nursing adverse event incidence rates before and after implementation (%): Falls/bed falls decreased from 2 (0.43%) to 3 (0.63%); identification errors from 1 (0.21%) to 1 (0.21%); other events from 12 (2.55%) to 5 (1.06%); total adverse events from 2 (0.42%) to 23 (4.89%); with a final value of 3 (0.63%) and P<0.001.

3.3 Nursing Work Quality Improvement (see Table 4) Table 4 compares nursing work quality scores before and after implementation (points, mean±SD): Admission nursing improved from 2.60$\pm$0.77to4.63$\pm$0.49; $communicationskills from$2.50$\pm$0.78to4 all P<0.001.

Discussion

4.1 Spatial Nursing Management Measures in Makeshift Wards Reduced Nursing Work Defects This study found that nursing work defect rates in makeshift hospital wards decreased after implementation. Makeshift wards primarily admit asymptomatic and mild COVID-19 patients. Regarding the Shanghai outbreak, the Omicron variant's transmissibility was 37.5% higher than the Delta variant [8]. Large patient volumes flooded makeshift hospitals, with Shanghai Lingang Makeshift Hospital admitting up to 5,684 patients in a single day [5]. This created safety hazards including concentrated admission times, high patient loads, heavy basic workloads, and multiple disease types and medication varieties. By introducing spatial management concepts, we divided high-risk warning zones, innovated nursing guide posts, and established safe ward order for large-volume admissions. Integrating "C-position" management thinking into warehouse management implemented standardized emergency material management requirements and improved daily work efficiency. Tabulating emergency cart internal spatial item placement and combining spatial positioning requirements with job responsibilities ensured continuity of condition monitoring and treatment during critical patient transfers while maintaining emergency effectiveness. The "rolling-shutter" method applied in terminal cleaning

of nursing units not only provided a new approach for addressing aerosol infection during COVID-19 patient discharge but also effectively protected medical staff safety and prevented nursing defects that might occur under conventional thinking.

4.2 Spatial Nursing Management Strategies in Makeshift Wards Improved Nursing Work Quality Study results showed that after implementing spatial management, nursing adverse event rates decreased and nursing work quality significantly improved. Nursing adverse events [9] refer to patient death, extended hospitalization, or disability at discharge resulting from medical nursing behaviors. Improved nursing quality effectively reduces adverse events and ensures nursing safety. The makeshift ward management model demonstrated three key characteristics: (1) Tight process control. The operation model shows that medical staff intervened from the moment patients arrived at the makeshift hospital entrance, with collaborative teamwork through epidemiological investigation → admission criteria assessment → admission guidance → hospitalization processing → treatment, with each step interconnected and complementary. (2) Detailed management. The model described how "attending physicians assessed admission criteria and sorted male/female patients into two lines; triage nurses affixed ward/bed number stickers to the outer upper side of patients' right lower limbs," demonstrating early intervention for classified admission and consideration of patients carrying various belongings. Placing stickers on the right lower limb freed patients' hands and prevented admission information errors. (3) Comprehensive spatial management thinking. The study shows spatial management concepts applied throughout physical spaces (architectural areas, treatment equipment management areas) and management spaces (nursing post management, admission/discharge management, critical patient transfer nursing), combined with process and detail control to construct a nursing quality control system for makeshift hospitals, thereby reducing adverse events and effectively ensuring patient safety.

Within the limited space and tight timeframe of the Pudong Lingang Makeshift Hospital, the nursing team innovatively introduced spatial management concepts, including effective area division with high-risk monitoring points, innovative nursing guide posts with position-based scheduling, "C-position" warehouse shelf management to improve material access efficiency, emergency cart internal structure diagram design to create spatial order for treatment items, spatial position management integration in patient transfer to implement fixed personnel and responsibilities, and "rolling-shutter" disposal method for innovative spatial volume management. These innovative and characteristic makeshift hospital work experiences received recognition from the National Health Commission and Jiangsu Provincial Health Commission, with promotional articles published in People's Daily Client and Xinhua Daily, representing valuable experience worth promoting.

References

[1] CCTV News. WHO lists novel coronavirus pneumonia epidemic as public health emergency of international concern [EB/OL]. [2020-01-31]. http://m.news.cctv.com/2020/01/31/ARTIn0Oug7Ap8qtMriCVOlmG200131.shtml.
[2] Urban Express. Starting at the end of February, with over 600,000 cumulative infections… Timeline of Shanghai epidemic [EB/OL]. [2022-05-31]. https://www.163.com/dy/article/H8N0H4EB051492LM.html.
[3] China News Network. (Shanghai Battle Against Epidemic) Shanghai Lingang Makeshift Hospital closes after multi-province collaborative management treating over 47,000 patients [EB/OL]. [2022-05-22]. http://news.haiwainet.cn/n/2022/0522/c3541083-32426500.html.
[4] Chen Zhenghong, Wang Bei, Wu Junyuan, et al. Application of nursing staff spatial position management in surgical patient transfer and handover [J]. Chinese Journal of Integrative Nursing, 2019, 5(10): 152-155.
[5] People's Daily Client Shanghai Channel. Shanghai Lingang Makeshift Hospital closes after 46 days and nights treating 47,224 patients [EB/OL]. [2022-05-22]. https://m.gmw.cn/2022-05/22/content_{1302958309}.htm.
[6] Zhou Junhui, Sun Huimin, Huang Wenli. Application of time-segmented daily inspection mode in nursing quality management of Wuhan makeshift hospital [J]. Chinese Nursing Management, 2020, 20(9): 1362-1364.
[7] CCTV News Client. National Health Commission releases "Diagnosis and Treatment Protocol for COVID-19 (Trial Version 9)" [EB/OL]. [2022-03-15].
[8] Guangming Net Society. Characteristics of Omicron variant [EB/OL]. [2022-03-13]. https://www.360kuai.com/pc/9f065bf57e536572c?cota=3&kuai_{so}=1&sign=360_{57c3bbd1}&refe
[9] 360 Encyclopedia. Nursing adverse events [EB/OL]. [2020-08-22]. https://baike.so.com/doc/2364556-2500318.html.

Note: Figure translations are in progress. See original paper for figures.