

# Strategic Deployment of ICU Nurses in Response to the Omicron Variant Epidemic in Shanghai

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**Objective:** In the first half of 2022, Shanghai faced the challenge of an emerging wave of epidemics caused by the Omicron variant. In response, 48 hospitals, spanning municipal and district levels, were rapidly converted into designated hospitals. This case study focuses on the South Branch of Renji Hospital, School of Medicine, Shanghai Jiaotong University, as one such designated hospital.

**Methods:** Facing unprecedented challenges without prior experience, we devised a strategic approach to deploy ICU nurses effectively. This approach involved crisis event gradation, establishing a human resources pool, and classifying nursing staff based on qualifications and proficiencies.

**Results:** By May 11, 2022, all 48 designated hospitals were operational. The South Branch of Renji Hospital treated 3310 Omicron-infected patients between April 7 and June 21, 2022, including 115 critically ill patients in a 38-bed ICU. We meticulously assigned 136 nurses, distributed as follows: Grade A 12.5%, Grade B 12.5%, Grade C 40%, and Grade D 35%, with three specialized nursing managers. Nurses worked tirelessly in 4-hour shifts, wearing full protective gear. Remarkably, the hospital maintained a flawless record, with no nursing-related adverse events and zero patient mortality in the ICU.

**Conclusion:** Effective management of ICU nursing personnel is associated with patient safety. Strategic rostering and placement of ICU nurses in designated hospitals optimize resource utilization, enhancing service effectiveness and working conditions. This technique is a crucial resource for hospitals facing unforeseen public health crises requiring rapid ICU nurse resource allocation and management.

**Keywords:** Omicron variant, pandemic response, designated hospital, ICU, nurse, human resource management, resource allocation

## Introduction

The SARS-CoV-2 Omicron was first detected as a novel coronavirus strain in Botswana and South Africa in November 2021.<sup>1</sup> In late February 2022, a sudden outbreak of Omicron BA.2 infections erupted in Shanghai, China. The variant's early indications of high contagion, reduced severity, and signs of immune evasion, potentially complicate pandemic management.<sup>2,3</sup>

Shanghai, with a population of over 25 million people, is one of China's most important international economic, financial, trade, and shipping centers.<sup>4</sup> The city's leadership immediately launched a series of stringent non-pharmaceutical interventions. From March 16th to March 27th, 2022, a street-level grid management system was implemented, methodically classifying areas as high-risk or non-high-risk based on quantifiable metrics such as infection rates and case numbers.<sup>5</sup> Despite extensive nucleic acid testing, these measures were insufficient to prevent transmission. The deteriorating situation prompted the imposition of a total lockdown in the Pudong district on March 28th, followed by a phased lockdown throughout the city, culminating in a complete citywide closure on April 1st. By April 13th, the epidemic's trajectory had shifted, indicating effective control. When the lockdown was lifted on June 1st, there had been 626,811 reported infections and 588 fatalities.<sup>6</sup>

In response to an increase in infected cases in Shanghai, including among the vulnerable elderly population, and an increase in severe manifestations, 48 hospitals at both the municipal and district levels were quickly designated to treat patients infected with the Omicron variant by May 11, 2022, providing a total of approximately 25,000 beds.<sup>7</sup> Our hospital is a sentinel admission hospital, in which the nurses in the ICU undertake the rescue and monitoring of critically ill patients throughout the hospital. ICU patients are more severe and have higher quality care requirements. Nursing human resource management will impact the patient's safety and the quality of work of the ICU nurses.<sup>8</sup> A systematic review also mentions that successful strategies for coping with the COVID-19 pandemic of manpower redeployment into the ICU include redeployment planning aimed to minimise training needs and maximise the use of redeployed HCWs' previous knowledge by placing healthcare workers (HCWs) in roles where their existing skills could be more easily transferrable.<sup>9</sup> Even though most tertiary hospitals across the country have implemented a flexible nursing pool to address staffing shortages and unexpected incidents, a unique deployment model catering specifically to ICU is lacking.<sup>10</sup> Confronted with a novel challenge that lacked any existing frameworks and was further complicated by a preponderance of severe and elderly patients, we got satisfactory outcomes by following the established management method based on the 4R Crisis Management Model, which will be detailed in further detail below.

## Methods

Built in 1844, Renji Hospital, School of Medicine, Shanghai Jiaotong University, has a history of nearly 180 years. It has been the first western medicine hospital since the opening of Shanghai. With an integration of medical treatment, teaching, and scientific research, it is a comprehensive 3A hospital (the top level of hospital ranking in China) with a complete range of disciplines. Up until now, Renji Hospital has consisted of four areas in total.

In response to an order from the Shanghai Municipal Health Commission, the South Branch of Renji Hospital, School of Medicine, Shanghai Jiaotong University underwent a rapid transformation to become a designated Omicron treatment center, with the conversion expected to be completed by April 7, 2022. The patient included those transferred from the general wards of other designated hospitals, secondary facilities, and makeshift hospitals. These designated hospitals primarily treated patients with chronic functional organ disorders, acute illnesses such as cardiovascular, digestive, and respiratory diseases, and vulnerable groups such as cognitively impaired individuals and unattended young children.<sup>7</sup>

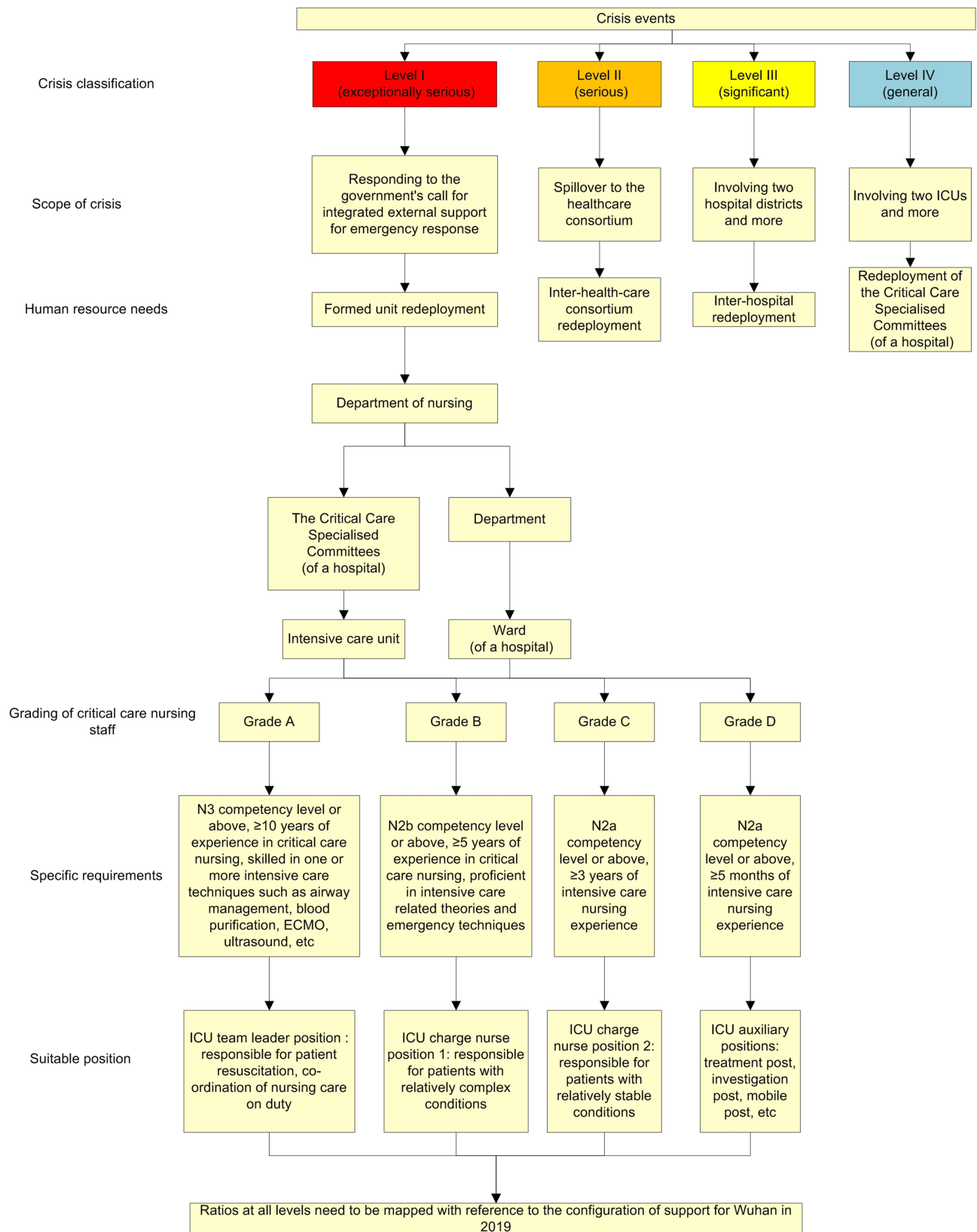
The South Branch of Renji Hospital, School of Medicine, Shanghai Jiaotong University was well-equipped, including general wards and an ICU section with 38 beds, demonstrating a comprehensive and well-thought-out strategy in addressing the multifaceted challenges of the ongoing epidemic.

## Theoretical Framework

As the core technique for dealing with HCWs during unforeseen public health incidents, this study incorporates Robert Heath's 4R Crisis Management Model—Reduction, Readiness, Response, and Recovery.<sup>11</sup> “Reduction” in this context refers to the redeployment of staff to specific ICUs in designated hospitals, along with a reduction in their original departments, most notably other ICUs. “Readiness” denotes the existence of emergency staffing plans in all departments; “Response” denotes the managerial reflection and summarization that occurs during the staffing reallocation process; and “Recovery” denotes the resumption of regular functions following the resolution of the crisis.

## Classification of Public Crises

A public crisis is a dangerous situation and an extraordinary state of affairs that seriously threatens and endangers the public interests of society and causes social chaos and public panic, necessitating the intervention of the public sector, primarily the government, to respond to and deal with it as soon as possible using public power, public policy, and public resources. According to the “National General Emergency Plan for Sudden Public Incidents” such crises are classified into four levels: Level I (exceptionally serious), Level II (serious), Level III (significant), and Level IV (general), which are represented by the colors red, orange, yellow, and blue, respectively. The recent epidemic-related lockdown in Shanghai was designated as a Level I (exceptionally serious) public crisis, resulting in comprehensive, system-wide support by government calls for emergency action, as shown in Figure 1.



**Figure 1** Process for Allocating ICU Nurse Human Resources in the Designated Hospital.

## Creating an ICU Nurse Human Resource Deployment Pool

The public crisis was of Level I (exceptionally serious), and the department's emergency manpower plan was insufficient to deal with it, therefore it was required to coordinate the deployment of manpower inside the hospital region. This pool included 2668 nurses from Renji Hospital's four areas, as well as nine ICUs, two general and seven specialized, with a total of 137 beds and 242 ICU nurses, 44 of whom had been dispatched to Wuhan for epidemic support. In China, standardized training refers to a 2-year rotation in various departments for new nurses with college degrees and bachelor's degrees, which must include a 5-month ICU rotation. Clinical nurses in our hospitals are categorized by years of experience into the following competency levels of competence:  $N0 < 1$  year;  $1 \text{ year} \leq N1 < 3$  years;  $3 \text{ years} \leq N2a < 5$  years;  $5 \text{ years} \leq N2b < 8$  years;  $8 \text{ years} \leq N3 < 10$  years;  $10 \text{ years} \leq N4 < 20$  years;  $N5 \geq 20$  years. In addition, China sent 344 national medical teams (42,322 in total) to Wuhan during the COVID-19 pandemic in 2020.<sup>12</sup> After this operation, the Shanghai Municipal Government revised the "Shanghai Three-Year Action Plan for Strengthening Public Health System (2020–2022)" to respond to future public health events that may occur, and focused on strengthening medical capacity in critical care during this period.<sup>13</sup> Shanghai Jiao Tong University School of Medicine responded to this call by establishing the Shanghai Public Health Incident Emergency Response Reserve Team Training Center, of which our hospital was one of the training bases. The training targets were non-critical care nurses (10% of the total number of nurses in the hospital).

Access criteria for the ICU nurse deployment resource pool were as follows: (1) age  $< 45$  years; (2) ward nurses with 3 or more years of experience and completed 5 months of ICU rotation training; (3) ICU nurses with 3 or more years of experience. Exclusion criteria: (1) ward nurses who have not received training from the Shanghai Public Health Incident Emergency Response Reserve Team; (2) 0 ~ 7 months of pregnancy; (3) with serious chronic diseases; (4) with serious mental illness; (5) personal unwillingness to join the resource pool.

The department of nursing categorized and assigned personnel based on competency levels, sub-specialties, and critical care skills, as shown in Figure 1. Furthermore, nurses in the ICU deployment resource pool were classified as temporary or permanent assistants based on the duration of their care. According to the program, if the support time was  $< 2$  weeks, they were mostly in relatively simple support positions; if the support time was  $\geq 2$  weeks, they were mostly in charge nursing positions.

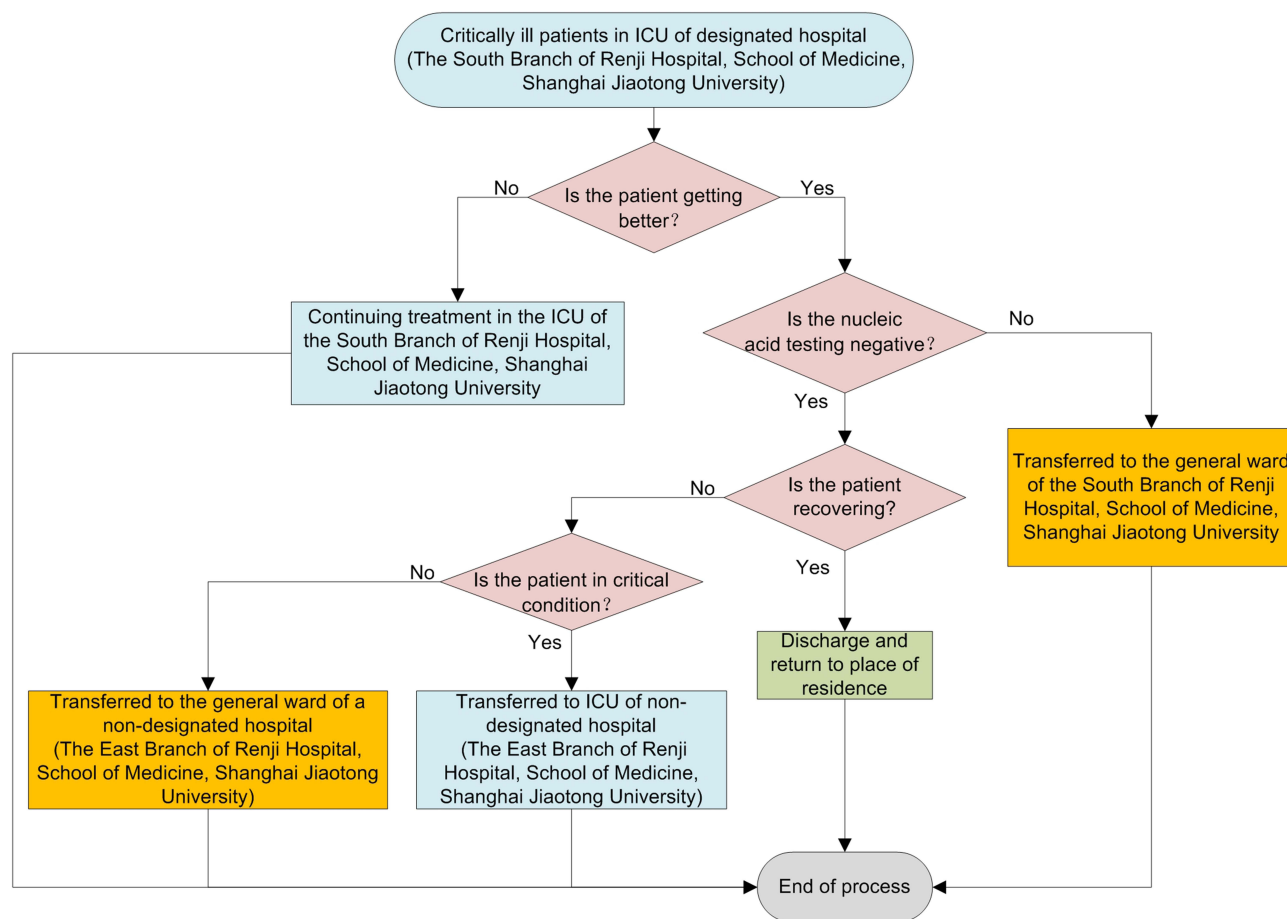
## Treatment in ICU

This program assigned nurses to the appropriate grade based on whether an invasive or non-invasive ventilator, blood purification, or ECMO was employed. Patients receiving non-invasive, high-flow humidification therapy in ICU were primarily cared for by Grade D personnel from the ICU nurse human resource deployment pool; patients receiving invasive ventilator care were primarily cared for by Grade B or C personnel; And patients on hemodialysis or ECMO were cared for by Grade A personnel.

Because wearing head-to-toe protective gear increased physical exertion, ICU wards had a shift every 4 hours<sup>10</sup> (ie, 4 hours of work time every visit to the cabin) to ensure the quality of care for critically ill patients and the personal safety of nurses. Nursing personnel with high fever, bone fracture, severe diarrhea, serious infection, big accidents or occurrences at home, and so on may be excused from work. Figure 2 elaborates on the patient transfer protocol in the designated hospital.

## Results

The South Branch of Renji Hospital, School of Medicine, Shanghai Jiaotong University admitted 3310 Omicron patients during its designation period. 115 of them were critically ill and were being treated in the ICU, which had 38 beds. A total of 136 ICU nurses were assigned to four grades (Grade A 12.5%, Grade B 12.5%, Grade C 40%, and Grade D 35%), as well as three additional managerial staff. Nursing-related adverse events that reflect patient safety and quality of care, such as medication error, falling out of bed, pressure injury, unplanned extubation, phlebitis or catheter-related infection, did not occur during the hospital's designated period.



**Figure 2** Process for ICU Patient Transfer-Out in the Designated Hospital.

Notably, The mortality rate during the patient's stay in the ICU was zero. After the outbreak in Shanghai was contained, the South Branch of Renji Hospital was sanitized and closed on June 21, 2022, and reopened as a general hospital on June 30, 2022.<sup>14</sup>

## Reflection and Summary

Compared to Mhawish's study,<sup>15</sup> both were task-based manpower grouping ratios, but the difference was that we had all received homogenized basic critical care competency training prior to deployment, and designated hospital administrators reinforced the consolidation of clinical inspectors for patient safety.

When the drawn nursing staff enters the designated hospital's ICU, the usual bed-to-nurse ratio configuration has not reached the standard of 1:2.5 to 3, which means that the department from which the staff is drawn is facing a reduction, especially in the ICU, where nurses are trained for a longer period. To better deal with potential future crisis occurrences, the human resources of ICU nurses should be continuously enhanced in terms of quantity in the future, with a specific amount set aside. Second, the hospital should boost its investments in intensive care training resources. Finally, more nurses on the wards, particularly senior nurses, should be encouraged to pursue training in intensive care specialties to build a more stable echelon of ICU nurse preparation.

## Conclusion

Human resource management is critical in shaping both patient safety and the quality of nursing in the ICU. This study pursued rational scheduling and allocation of ICU nurses at specific hospitals, resulting in an optimization of human resources and allowing the nursing team to work at peak efficiency. Future endeavors should include increasing the distribution of ICU nursing human resources, as well as expanding intensive care training resources, to build a more

balanced ICU nursing reserve team. Limitations of the study: this is our practice program as a designated hospital in the new round of epidemic in Shanghai, but due to time constraints, we did not carry out the Delphi expert consulting demonstration. Future research will include expert consultation to further improve the ICU nurse human resources deployment program in designated hospitals. Although other public health emergencies may occur in the future, this management technique can still serve as a model for the quick deployment and management of ICU nurse manpower in hospitals.

## Implications for Policy and Practice

- The prompt establishment of an ICU nurse manpower resource pool, in conjunction with prudent ICU nurse management policies, is associated with patient safety. Despite limitations, the efficacy of this strategy is confirmed.
- As COVID-19 spread around the world, many countries were dealing with the dual challenge of a growing number of critically ill and aging patients. In the event of future major global public health events, our initiative could serve as a model, providing benchmarks and guidance for the distribution and governance of ICU nursing human resources in other parts of the world.

## Ethics

This research was approved by Shanghai Jiao Tong University School of Medicine, Ren Ji Hospital Ethics Committee (No.:LY2022-003-B).

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## Author Contributions

All authors contributed significantly to the work reported, whether in the conception, study design, execution, data acquisition, analysis, and interpretation, or all of these areas; participated in drafting, revising, or critically reviewing the article; gave final approval of the version to be published; agreed on the journal to which the article was 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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