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Changes that Intensive Care Unit Should Make in the Post-Epidemic Era

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Abstract: *The novel coronavirus (covid-19) pandemic of 2019 poses significant challenges to the healthcare system, some of which will lead to transformative changes. With the fact that covid-19 is currently under control, the post-pandemic era will require appropriate changes in the intensive care unit (ICU) to adapt to the changes in the post-pandemic era, including the need for ICUs to be prepared to accommodate patient surge, prevent shortages of personal protective equipment, ICU equipment, consumables, and medications, and more rational and safe ward planning. Pre-existing training and stockpiling of critical care professionals and training of existing medical and nursing staff in basic operations. Pre-existing ICU triage and remote control have been emphasized and implemented. covid-19 pandemic reminds us that we are committed to improvement beyond the core responsibilities that already exist. By addressing these challenges in advance, we will be able to provide better care for future patients.*

Keywords: *Covid-19, Pandemics, Critical Care, Surge Capacity, Triage*

1. Introduction

Since December 2019, the covid-19 pandemic has infected more than 480 million patients and resulted in more than 6.1 million deaths worldwide. Unfortunately, cases continue to persist across the globe, with many countries facing an even larger wave of infections, some of which are even more worrisome than the former. Healthcare systems have been challenged, but have also shown remarkable resilience [1]. Even in the post-epidemic era, some of these changes will be transformative and will affect the way we provide intensive care.

The intensive care unit has seen major developments after each major disaster, and the ravages of covid-19 this time have brought attention to the intensive care unit, with the possibility of culling beds in almost all specialties, except for ICU beds, which may increase, accompanied by a significant shortage of talent in related specialties [2], not just to meet the current shortage while the pandemic is still ongoing In today's pandemic, not only to meet the current shortage, but also to cope with the possibility of recurrence of epidemics or other disasters, it is necessary to increase the training of professionals in critical care medicine.

As the last line of defense to guard the lives of critically ill patients, the intensive care unit (ICU) faces enormous pressure and responsibility. Serious deficiencies were revealed during the pandemic, and with the fact that covid-19 was under control, the lessons to be learned in the ICU should not only be about contingency planning in times of "stress" but also about new habits that will benefit us in the event of a future disaster, whether it is a high-threat pathogen or a non-infectious, multi-casualty event. This review focuses specifically on the deficiencies revealed in the ICU during the COVID-19 pandemic and some thoughts on the shifts that should be made in the post-epidemic era that are not covered in detail elsewhere.

2. Dramatic Increase in the Number of Patients, More Severe Disease, and Shortage of Items

During the covid-19 pandemic, the need for ICU bed capacity increased rapidly [3, 4], and during

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the first wave of the pandemic, health care workers used a variety of temporary methods to expand ICU bed capacity. Although these methods helped to weather the crisis, they still faced logistical challenges, including inadequate medical gas outlets, insufficient electrical capacity, poor patient visibility, poor infection control conditions, and differences in maintaining separation between covid-19 and non-covid-19 patients. In addition to this, the lack of ventilators and a severe shortage of medical staff were key considerations.

Additional equipment and items that were lacking during the peak of the pandemic - including but not limited to personal protective equipment, monitoring systems, intravenous supplies, and medications - also contributed to significant patient morbidity and mortality and limited the number of patients who could receive effective critical care . The lack of 50cc syringes, closed tracheal inhalation systems, and disposable respiratory circuits was equally evident during the peak of the pandemic, necessitating the ongoing evaluation of high-utilization materials to prevent shortages [5].

In the post-pandemic era, even though the surge in patients is not as pronounced as during a pandemic, ICUs are still at risk of covid-19 recurrence, and with the aging population, the proportion of critically ill elderly patients in the perioperative period and after organ transplantation has increased significantly, as well as the increasing health needs of the population, ICUs need to be equipped with additional beds and facilities, and a possible solution to this assessment is Create "alternate ICUs" where non-intensive care units (such as emergency rooms, post-anesthesia care areas, or even regular wards) can be designed to be converted into ICUs when needed, ideally physically connected to or close to "regular" ICUs. These "back-up ICUs" should be pre-selected; should have appropriate infrastructure, including medical gases, suction and infection control facilities; and should allow for rapid installation of cardiac function monitoring and cardiopulmonary support. Once there is a surge of critically ill patients, the "backup icu" can be restored to its original function [6]. In addition to this, there is a need for adequate supplies of commonly used high-utilization materials in the ICU, and it is necessary to continuously assess high-utilization materials to prevent unpredictable shortages [7].

In the context of having experienced a pandemic, we need to develop comprehensive lists of required essential supplies and equipment that may also be applicable to the covid-19 population, and it is important to note that the duration of mechanical ventilation and hospital stay in covid-19 patients may be longer than in infusion patients, so that in the event of another covid-19 pandemic (or other bacterial or viral pandemic) the original inventory may be underestimated. And in the context of a pandemic, many supply chains may be disrupted and there is a clear inventory and advance knowledge of which supplies may be depleted, and if they cannot be replenished, either devices or drugs should be replenished or alternatives identified as early as possible.

3. A Safer ICU Unit

The covid-19 pandemic exposed the limitations of the current ICU design model. One issue is the use of single rooms and centralized wards, where single rooms can provide more privacy and higher patient and family satisfaction, reduce the likelihood of cross-contamination with other patients, and reduce the risk of psychiatric disorders [8, 9]. However, the availability of single rooms varies widely between ICU and between countries [10], and in addition, in a pandemic, there are never enough single rooms, and even temporary square-cabin hospitals are created due to lack of beds. When the patient-to-nurse ratio is high, which is the general situation in resource-poor settings and may occur in resource-rich settings during a pandemic, then closed single rooms may increase the risk to patients due to reduced visibility and clutter of hearing alarms. In these situations, centralized ward management offers the advantages of lower operational costs, efficient use of health care resources and limited personal protective equipment (PPE) savings [11], and the concepts of single rooms and centralized wards are not mutually exclusive, as single rooms can be used to handle two patients in "normal times", provided appropriate infrastructure is in place. This facilitates the expansion of the capacity of the intensive care unit.

Another issue is the placement of patient equipment. Traditional ICU design places equipment around the patient's bedside. This forces the ICU physician or nurse to frequently enter the room for non-patient contact reasons, such as viewing waveforms, adjusting equipment settings, or responding to alarms. In a pandemic, this type of work may increase the consumption of personal protective equipment or exposure to other pathogens.

Conceivably, ICU rooms in the post-pandemic era should be remodeled to provide patient-centered treatment and care that is accessible and visible to patients from the outside, while allowing access and

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control of equipment for remote care and minimizing non-direct patient care entry. At the same time, privacy and a quiet environment are important to patients. Expert guidance on ICU capacity expansion due to covid-19 based on practical experience.

4. Late Start of Critical Care Medicine and Shortage of Specialized Medical Staff

With the surge of critically ill patients after the covid-19 outbreak, the pandemic quickly overwhelmed the health care system [12], forcing hospitals to adopt crisis management standards. In terms of emergency and crisis capacity, hospitals needed to more than double their ICU capacity. Both high-income and low-income countries have revealed shortcomings in healthcare staffing [13, 14], and in an international survey of 2700 ICU staff since the covid-19 pandemic outbreak, 32% of respondents reported shortages of ICU nurses (24% in East Asia and the Pacific to 57% in South Asia) compared to 15% of ICU physicians (from 12% in North America to 50% in sub-Saharan Africa) [15]. During the pandemic, hospitals used a variety of approaches to respond to the increasing demand for ICU patients, and what is our long-term solution in the post-pandemic era? Due to the general shortage of ICU nurses, physicians, and other professionals, there is a need to reconsider how to increase the number of students in critical care medicine. The problem is that the Department of Critical Care Medicine has only gained rapid progress and development in the last three years, but due to its late start, the overall size cannot be compared with other established disciplines. The development of the Department of Critical Care Medicine must meet the needs of three dimensions, firstly, to meet the needs of routine care, secondly, to meet the emergency and temporary needs such as plague and disaster, and thirdly, to have an adequate strategic reserve of critical care.

Some studies have shown that increased investment in ICU human resources can further improve the quality of ICU medical services in China [16], therefore, in the future covid-19 coexistence with human beings, the medical education system from the national level should be adjusted accordingly, adjusting the current system of specialized training "cautious, prudent, small-scale The working principle of "prudent, steady and small scale", further increase the training of talents in critical care medicine, expand the number of training bases, increase the number of training quotas, explore a set of orderly training system, and continuously and steadily train qualified specialists for public hospitals. From the perspective of ICU specialty, it is more necessary to cultivate talents with higher and stronger professional ability and literacy to be able to face more sudden disasters and unknown challenges, so that ICU can come into the public's view and make more people understand ICU, thus attracting more medical students to choose ICU.

5. Insufficient Protection Training for Medical Personnel and Lack of Wartime Drills

For many years, large public hospitals have generally attached great importance to scientific research, and the lack of attention and investment in the comprehensive capabilities of medical personnel. At the beginning of the pandemic, it was common that medical staff were not skilled enough to master the operation of donning and doffing protective clothing, but the much-needed donning and doffing skills during this covid-19 pandemic required a high level of practical ability and the necessary number of training sessions had to be conducted to achieve contamination-free requirements. The literature reports that only 23.33% of medical staff can fully master the process. A significant amount of emergency hands-on training and personal protection training is needed on an ad hoc basis to reduce the risk of viral infection, and medical staff who do not fully master the skills required to participate in frontline medical work will be at increased risk of exposure.

This pandemic highlights the lack of attention to comprehensive competency development for medical staff, including protective skills, in public hospitals. The lack of investment in continuing education departments and clinical skills training centers, which are the main focus of developing the competencies of medical staff, is evident. In the post-epidemic era, there will be another outbreak of covid-19 pandemic or other infectious diseases or other acute disasters in a certain place at any time within a long period of time, therefore, ICU should have the ability to deal with sudden disasters for a long period of time. It is important to make sure that all ICU professionals know how to perform first aid measures. Therefore, improving the proficiency of emergency skills in hospitals, especially in ICU, will be an easy way to deal with various sudden disasters in the future.

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6. ICU Patient Triage

During the covid-19 pandemic, many intensivists were asked to make decisions about who should and should not be admitted to the ICU [17], and some foreign centers used the "lottery" or "first come, first served" principle to prioritize patients. "This approach is not appropriate in life-threatening situations. Since there is no single criterion to capture all ethically relevant values, then a multi-principle allocation framework has been suggested as the most appropriate way to prioritize which patients receive critical care management and, depending on the context, a classification framework with other institutions at the local, regional, or national level, as well as inter-hospital referral procedures. Triage teams are a strategy that may take on more responsibility for triage decisions that are difficult for frontline clinicians to make. They include experienced clinicians (nurses and physicians), bioethicists, and community members who apply and incorporate social review criteria.

7. Remote Control of Medical Care

During the pandemic, some intensive care units connected patient equipment, including infusion pumps, physiological monitoring devices, and even ventilator control panels, outside the room to be delivered to patients via extended tubing or lines. Others have established remote control of devices using Wi-Fi or Bluetooth systems, or even artificial intelligence (AI) algorithms to administer vasopressure drugs. This saves health care workers' protective equipment and reduces the risk of health care worker exposure.

The main purpose of the remote ICU is to ensure better treatment and care for the lives of critically ill patients by having experienced critical care nurses and intensivists monitor ICU patients remotely and in real time. Because ICU patients are critically ill, they often have multiple diagnoses and need to respond promptly to various events and incorrect treatment measures. Nurses in the remote ICU are constantly monitoring automated clinical data and have access to bedside cameras. Remote ICU personnel have access to all records of patient care activities in the clinical record. The remote ICU nurse contacts the ward ICU nurse by phone or electronic note pad, and the ward ICU nurse can contact the remote ICU nurse by phone or through the emergency call button at the bedside. The remote ICU nurse can check in through the relevant information system and report timely and accurate clinically relevant information.

Many hospitals had already used remote controlled medicine in ICUs before the pandemic, but it was not widely implemented, and this covid-19 pandemic may be a turning point in the digital transformation of the critical care field [18]. Looking at the hospitals using tele-ICU platforms in this covid-19 pandemic, tele-ICU is a key strategy to address the decentralization of core healthcare resources. The greatest benefits are the savings in protective equipment and reduced risk of health care worker exposure, the ability of health care workers to complete care through remote operations, and the ability to achieve more frequent patient interactions, while changing the workflow and alleviating the shortage of health care workers. In the post-epidemic era, the development of telemedicine will be an important direction.

8. Conclusion

The covid-19 pandemic serves as a warning to us that ICUs should have greater resilience to respond to a variety of emergencies in addition to the core care responsibilities they should have. We have a unique and urgent opportunity to use current information about the positive impact on patient care during a pandemic to change the way we work and mitigate future health disasters. We can also reevaluate strategies for patients, families, and health care providers to improve care. In the post-pandemic era, critical care is more powerful than ever.

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