

Original Article

JAAM nationwide survey on the response to the first wave of COVID-19 in Japan. Part II: how did medical institutions overcome the first wave and how should they prepare for the future?

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Aim: To investigate and clarify the surge capacity of staff/equipment/space, and patient outcome in the first wave of coronavirus disease (COVID-19) in Japan.

Methods: We analyzed questionnaire data from the end of May 2020 from 180 hospitals (total of 102,578 beds) with acute medical centers.

Results: A total of 4,938 hospitalized patients with COVID-19 were confirmed. Of 1,100 severe COVID-19 inpatients, 112 remained hospitalized and 138 died. There were 4,852 patients presumed to be severe COVID-19 patients who were confirmed later to be not infected. Twenty-seven hospitals (15% of 180 hospitals) converted their intensive care unit (ICU) to a unit for COVID-19 patients only, and 107 (59%) had to manage both severe COVID-19 patients and others in the same ICU. Restriction of ICU admission occurred in one of the former 27 hospitals and 21 of the latter 107 hospitals. Shortage of N95 masks was the most serious concern regarding personal protective equipment. As for issues that raised ICU bed occupancy, difficulty undertaking or progressing rehabilitation for severe patients (42%), and the improved patients (28%), long-lasting severely ill patients (36%), and unclear isolation criteria (34%) were mentioned. Many acute medicine physicians assisted regional governmental agencies, functioning as advisors and volunteer coordinators.

Conclusion: The mortality rate of COVID-19 in this study was 4.1% of all hospitalized patients and 12.5% (one in eight) severe patients. The hospitals with dedicated COVID-19 ICUs accepted more patients with severe COVID-19 and had lower ICU admission restrictions, which could be helpful as a strategy in the next pandemic.

Key words: COVID-19, ICU management, medical staff, survey

INTRODUCTION

THE WORLD HEALTH Organization declared the coronavirus disease (COVID-19) outbreak a global pandemic on 10 March, 2020.¹ The number of confirmed

COVID-19 cases in Japan increased at the end of March,² reaching 600 new infections/day in the middle of April. The number of new infections decreased at the end of May 2020. During the above time period, all medical staff in Japan provided medical treatment to COVID-19 patients, particularly acute (emergency) medicine physicians, intensivists, infectious disease experts, and pulmonologists. We describe how to strengthen the system for COVID-19 patients from a nationwide survey distributed to acute medicine medical centers certified by the Japanese Association for Acute Medicine (JAAM).

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In this study, we describe patient outcomes regarding severity and address how we should carry out medical care post-COVID-19. We analyzed the data from the survey mentioned above.

METHOD

Surveyed hospitals and time allotted for response

THE JAPANESE ASSOCIATION for Acute Medicine is Japan's academic clinical society for acute medicine and has approximately 11,000 members. The society constructed a system of board certification for acute medicine physicians and certifies acute medicine medical centers suitable for the training of acute medicine physicians. We surveyed 513 acute medicine medical centers certified by JAAM, based on their status at 31 May, 2020. Time allowed for response was from 8 to 27 June, 2020.

Questionnaire and form

The survey was constructed using Google Forms and each institution submitted answers through the website. All fields were mandatory except the questions about ideas for improvement at each hospital.

Institution details

Location, number of beds, category of institution, emergency medical care system, specified hospital fee for critical patients, number of acute medicine physicians

1. Hospital system designated to treat COVID-19

Task force in hospital, guideline setting, business continuity plan, infection control team/system, outpatient management for fever or flight back, severity of COVID-19 wards, specialty of attending doctor, management of hospital beds, number of beds for COVID-19 patients, situations when medical treatment was restricted, competency

2. Initial medical treatment system

Protection from infection in the emergency room, availability of polymerase chain reaction/antigen exam system, treatment of suspected patients infected with the COVID-19 virus, number of suspected infected patients, what is considered an advantage of acute medicine physician against COVID-19

3. Medical equipment

Supply and demand of personal protective equipment (PPE) and medical equipment

4. Overworked medical staff and a care system for them

Stress-identifying system and mental health-care in the hospital, sources of stress, overtime work, management of work shift/support system among departments, factors

related to surviving the first wave, contributions to prefecture/regional medical control system

5 Outcome of COVID-19 patients

Number of hospitalized patients of each severity, discharge, transfer, still hospitalized, worsening, death

Description and analysis

Regarding patient severity with COVID-19, moderately severe patients were defined as patients who required oxygen administration and severe patients were defined as patients who required ventilator assistance, extracorporeal membrane oxygenator, or management in an intensive care unit (ICU). In addition, to evaluate the condition of restriction of elective surgery/ICU admission/acceptance of emergency patients placed on the hospitals with COVID-19 patients, we compared the hospitals with COVID-19-dedicated ICUs ($n = 27$) to the hospitals with COVID-19 and non-COVID-19 patients in the same unit ($n = 107$). The χ^2 -test was used to test differences between two groups.

RESULTS

Outcome of COVID-19 hospitalized patients

A TOTAL OF 4,938 hospitalized patients with COVID-19 were confirmed. Outcome of the COVID-19 hospitalized patients is shown in Figure 1. Of the 3838 moderately severe patients, 62 patients died, 259 worsened to severe, and 392 remained hospitalized. Of the 1,100 severe patients, 138 died and 112 remained hospitalized. In addition, there were 4,852 suspected cases who were possibly infected with COVID-19 virus and experienced severe illness. A total of 1,845 patients were admitted to the emergency ICU and 615 were admitted to the surgical ICU or mixed ICU (data not shown).

How to manage the ICU for severe COVID-19 inpatients

For severe COVID-19 patients, 27 hospitals (15%) converted their ICU to a unit for COVID-19 patients only, and 107 (59%) managed a portion of the ICU for COVID-19 patients, as many hospitals accepted three or more severe inpatients (Fig. 2A). Of 1,100 severe COVID-19 patients, 353 (32%) were treated in the 27 hospitals with COVID-19-dedicated ICUs. Some hospitals rebuilt the ICU, HCU, an old ward into a specialized care unit, or set up a temporary unit. Figure 2B shows the number of the hospitals that restricted ICU admission for each type of ICU management. The number of hospitals that restricted ICU admission was

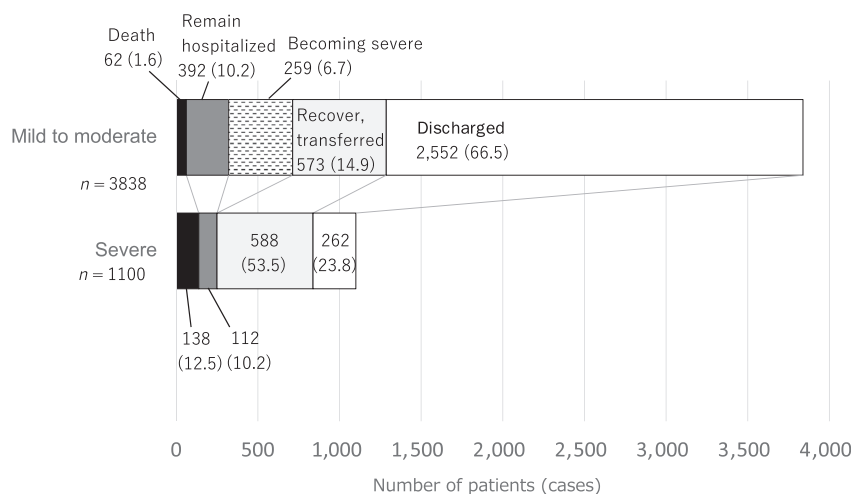


Fig. 1. Outcomes of COVID-19 patients in 180 Japanese hospitals as at 31 May, 2020. Data are shown as n (%).

significantly lower in hospitals with a COVID-19-dedicated ICU than in hospitals with COVID-19 and non-COVID-19 patients in the same unit (1/27 versus 21/107, $P < 0.05$). There was no difference in the limitation of elective surgery (data not shown) or emergency patient acceptance (Fig. 2C).

Severe COVID-19 patients were mostly admitted to the emergency ICU, followed by the mixed ICU and the surgical ICU. Figure 3 shows the number of hospitals restricting ICU admissions for non-COVID-19 patients, restricting elective surgery (upper panel), and limiting emergency patients (lower panel) occurred in more than half of all hospitals during the survey period, despite the number of severe inpatients. Conversely, 17% of hospitals could not be restricted from accepting emergency patients despite the increased workload. As shown in Figure 4, 169 (94%) hospitals prepared ICU beds for severe COVID-19 patients. Seventy-seven hospitals prepared ICU beds, although they had to restrict elective surgery or non-COVID-19 ICU admissions.

Shortage of medical devices and equipment

In Figure 5A, (in)sufficiency of PPE is indicated by how many days the protective equipment could be changed. Only a limited number of hospitals could permit changing PPE for each patient. Shortage of N95 masks was most pronounced. Medical staff had to use the same N95 mask all day in 49 hospitals (27%) and for ≥ 2 days in 101 hospitals (56%). Shortage of surgical masks, face shields, and eye shields occurred as well. Fifty-five medical institutions designated for specified infectious diseases (out of 180 hospitals), also suffered from shortages of equipment (Fig. 5B). Other than the above-mentioned equipment, many hospitals

experienced shortages of plastic gowns (112 hospitals, 62%), surgical gowns (74 hospitals, 41%), goggles (72 hospitals, 50%), and alcohol-based hand sanitizer (65 hospitals, 36%), which occurred in hospitals that accepted five or more mild to moderate inpatients or accepted one or more severe inpatients with COVID-19, as well as other hospitals (Fig. 6). In addition, some hospitals were concerned about the quality of PPE, such as N95 and surgical masks, over quantity, and other hospitals lacked batteries for their video laryngoscopes.

Difficulties with treating hospitalized COVID-19 patients

Figure 7 reveals the difficulties encountered when treating hospitalized COVID-19 patients. Difficulty in carrying out or progressing rehabilitation for severe patients (42%), as well as for improved patients (28%), was observed. Long history of severely ill patients (36%) and unclear isolation criteria (34%) also resulted in occupied ICU beds.

Preventing future emergency department infections

We asked what type of emergency patients emergency physicians donned advanced PPE for, and how long the continued use of advanced PPE should be with patients of unknown COVID-19 status (Fig. 8).

In 85 hospitals, emergency physicians wore advanced PPE only with cases of suspected COVID-19 infection based on medical history and symptoms. In contrast, advanced PPE was used for all emergency patients, and all patients with possible aerosols in the remaining 95 hospitals.

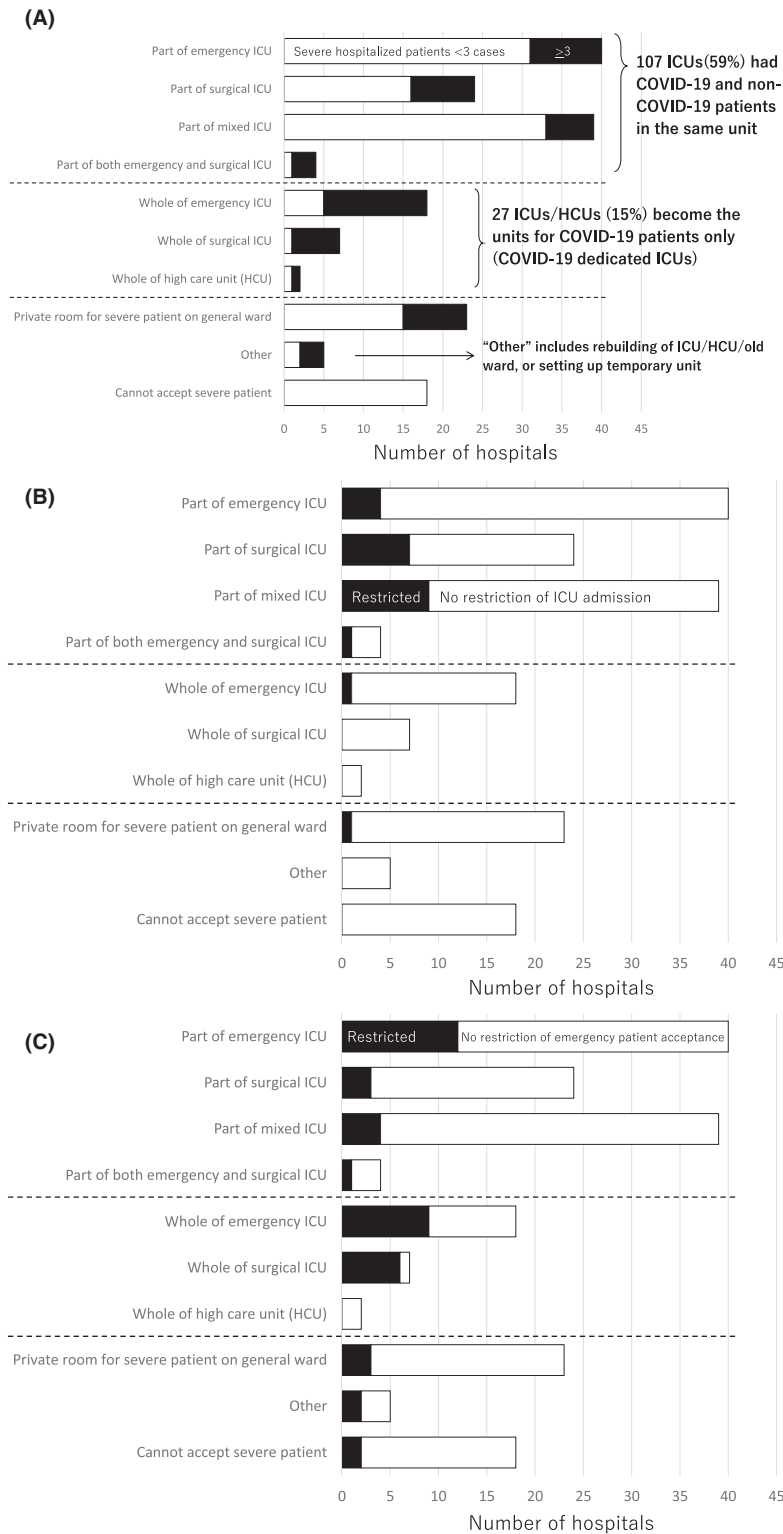


Fig. 2. Types of intensive care unit (ICU) management for severe COVID-19 patients in Japan and (A) number of hospitalized severe COVID-19 patients, (B) restriction of ICU admission, and (C) restriction of acceptance of emergency patients. HCU, high care unit.

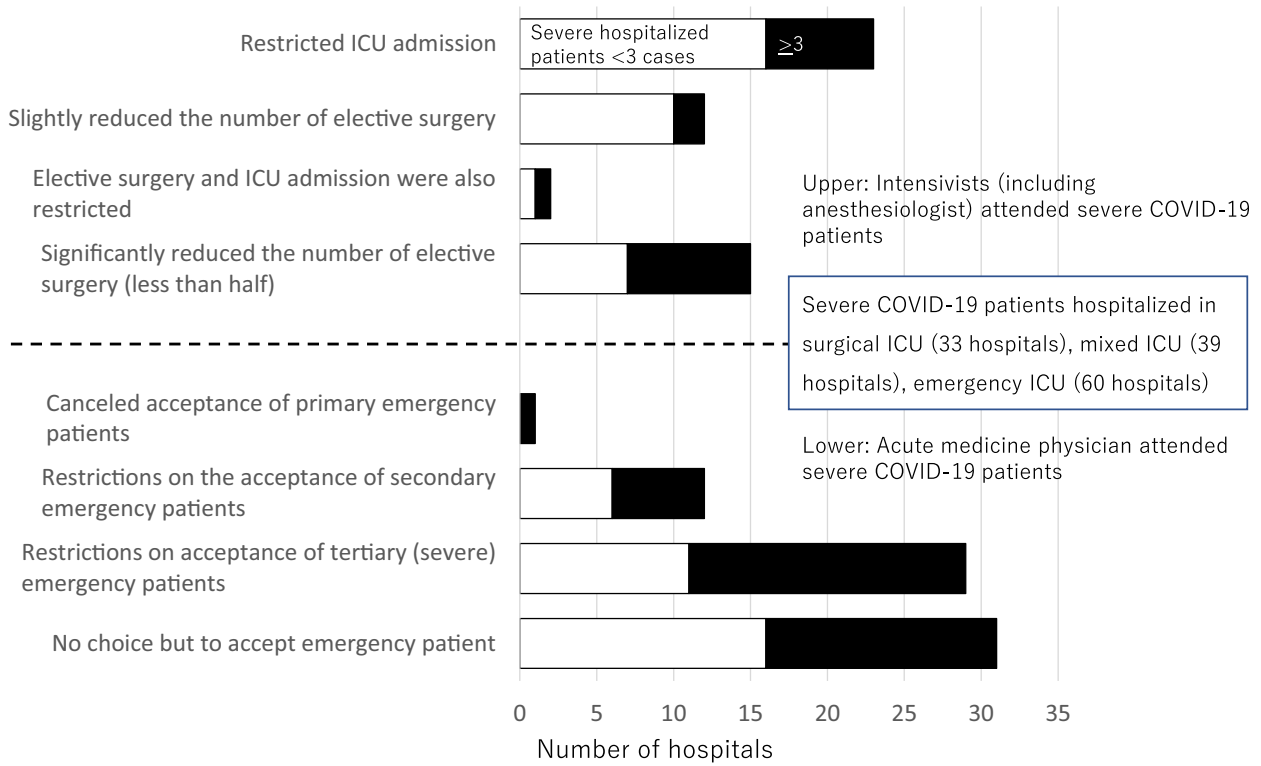


Fig. 3. Restriction of intensive care unit (ICU) admission, elective surgery of non-COVID-19 patients, and limited acceptance of emergency patients in Japanese hospitals during the first wave of COVID-19 in Japan. Filled bars, hospitals with three or more severe patients ($n = 57$, total); open bars, other hospitals ($n = 123$, total).

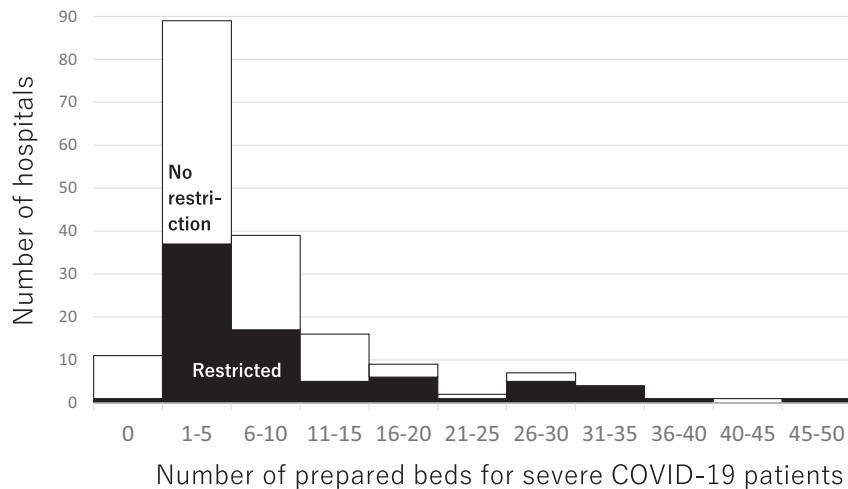


Fig. 4. Number of intensive care unit beds prepared for severe COVID-19 patients in 169 Japanese hospitals during the first wave of COVID-19. Filled columns, hospitals that restricted intensive care unit admission or elective surgery of non-COVID-19 patients.

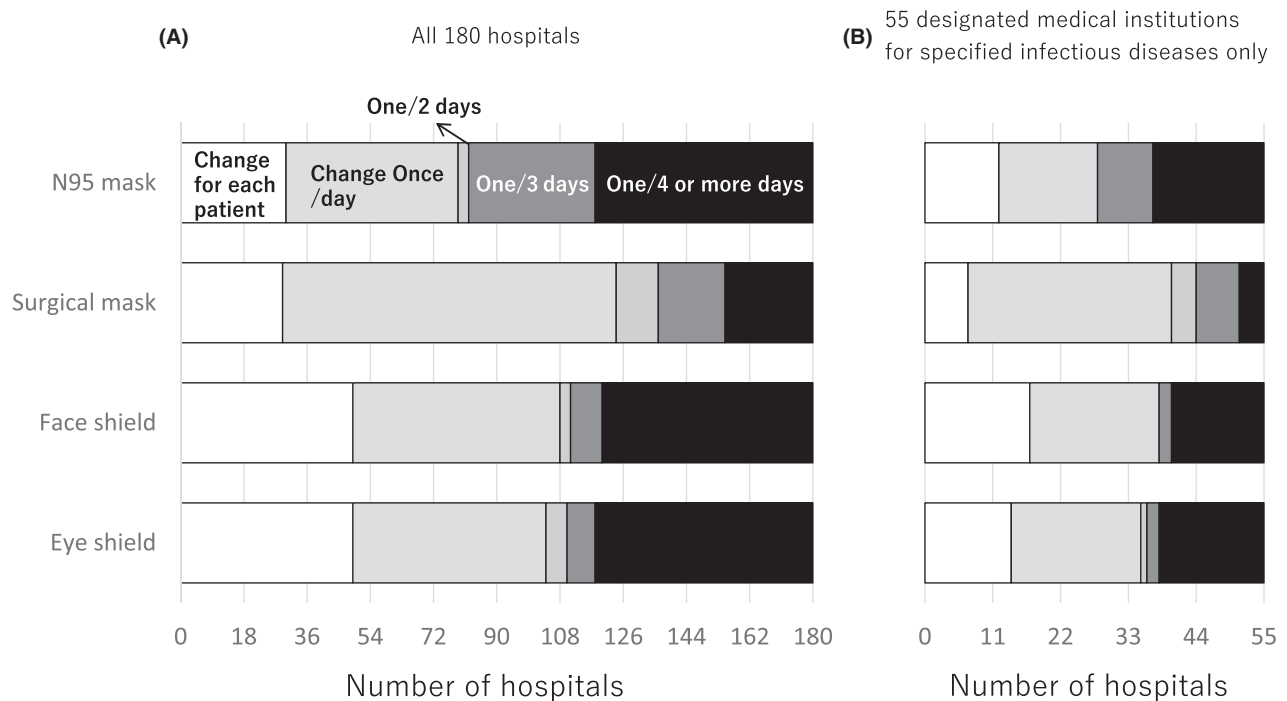


Fig. 5. Personal protective equipment sufficiency during the first wave of COVID-19 in (A) 180 Japanese hospitals and (B) 55 medical institutions designated for specified infectious diseases.

In these 95 hospitals, 35 hospitals (35%) thought using advanced PPE should continue until COVID-19 vaccination occurred, 16 (17%) thought its use should continue until COVID-19 remedies became common, and 16 (17%) thought its use should continue until a high proportion of the population has antibodies. Advanced PPE for all future patients was considered necessary in the final 14 hospitals (15%).

DISCUSSION

AFTER MUCH effort, the Japanese people overcame the first wave of COVID-19 infections at the end of May 2020, following a cluster of cases infected on a cruise ship.³ We asked staff at 180 flagship hospitals questions in a nationwide survey, and more than half of hospitals reported that Japan's success in controlling the spread of COVID-19 was due to avoiding overwhelming hospitals and decreasing unnecessary ambulance calls when there is no true emergency.

Many hospitals had to convert their emergency/surgical/mixed ICUs to a specialized care unit for COVID-19 patients. This conversion resulted in restricted elective surgery and ICU admissions. Additionally, restrictions occurred even in hospitals that accepted fewer than three severe inpatients and when hospitals used a portion of their ICU for

COVID-19 beds. It could be that severe COVID-19 inpatients require more medical staff because of their isolated treatment teams and zoning within the unit. Interestingly, 15% of hospitals with dedicated COVID-19 ICUs had a higher percentage of patients with severe COVID-19 (32%). Furthermore, these hospitals did not differ in limiting elective surgeries or admitting emergency patients but had lower restrictions on ICU admission. Difficulties in progressing rehabilitation, unclear isolation criteria, and patients who cannot easily move to a general ward after ICU treatment, all remain problems preventing more patients from exiting the ICU. These reasons, as well as long-lasting COVID-19 infection⁴ resulted in high ICU bed occupancy in many hospitals.

In this study, a total of 4,938 hospitalized patients with COVID-19 were confirmed. It was found that one in 12 COVID-19 patients whose severity was mild to moderate on admission became severe or died. One in eight patients with severe COVID-19 died. In this survey, the number of severe patients who needed mechanical ventilation, extracorporeal membrane oxygenation, or ICU admission was 1,100 (22%), which is higher than similar studies, revealing that the corresponding numbers were 14.2% of 5,700 hospitalized patients in the New York City area,⁵ and lower than 30% of 377 inpatients in California.⁶ Among patients who

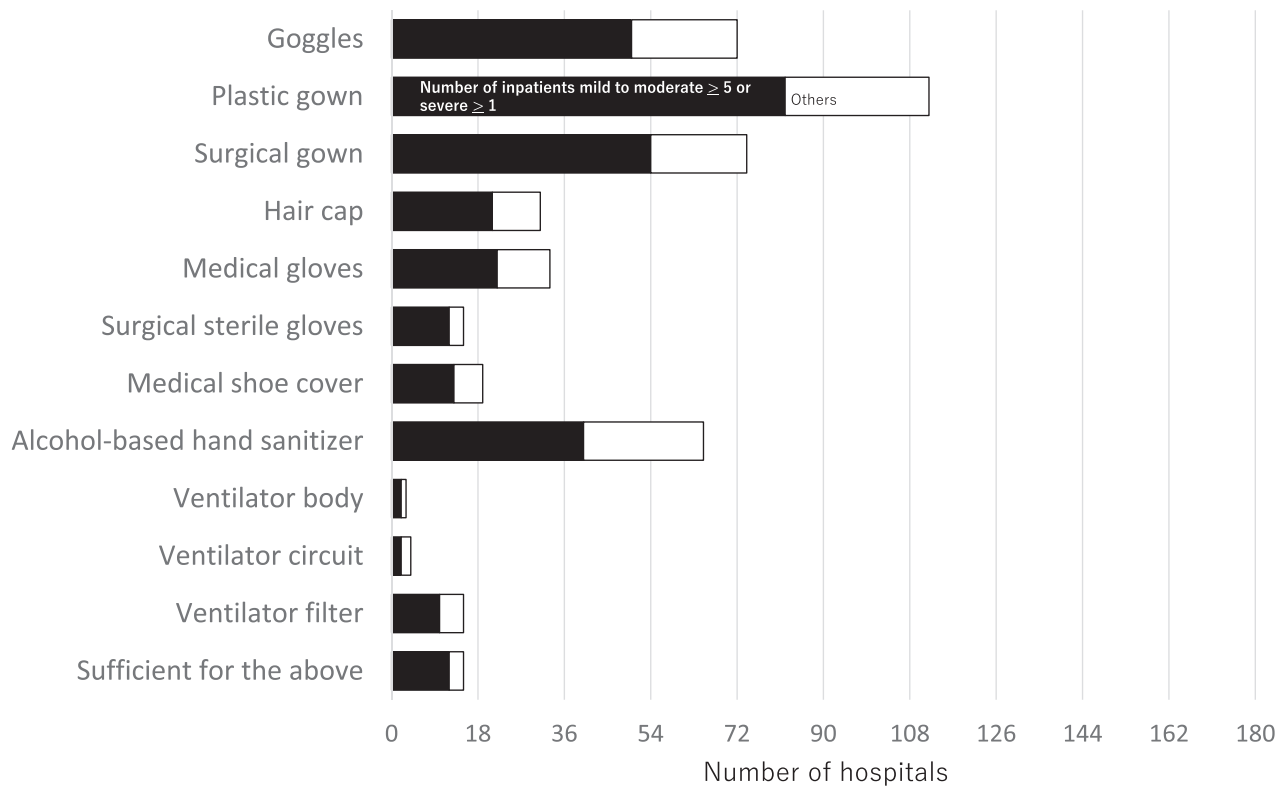


Fig. 6. Shortage of medical equipment other than N95/surgical masks and face/eye shields during the first wave of COVID-19 in Japan. Filled bars, hospitals with five or more mild to moderate patients or one or more severe patient ($n = 130$, total); open bars, other hospitals ($n = 50$, total).

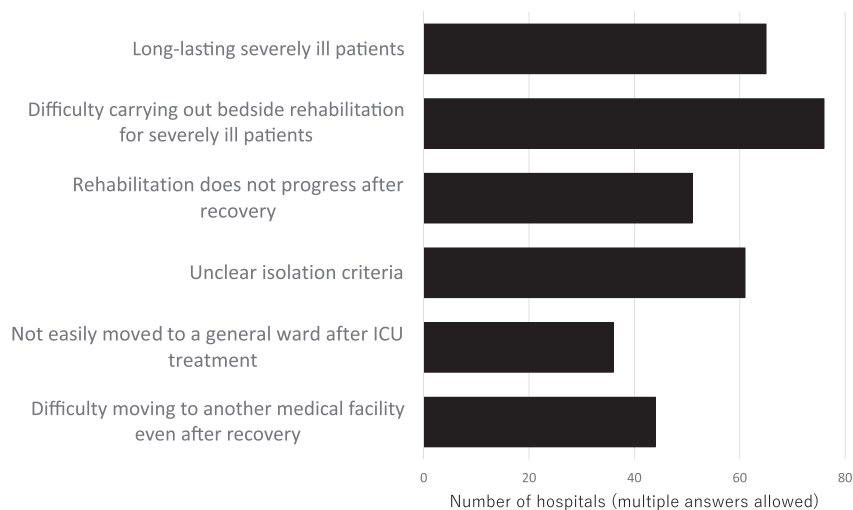


Fig. 7. Difficulties in managing hospitalized severe COVID-19 patients during the first wave of COVID-19 in Japan. ICU, intensive care unit.

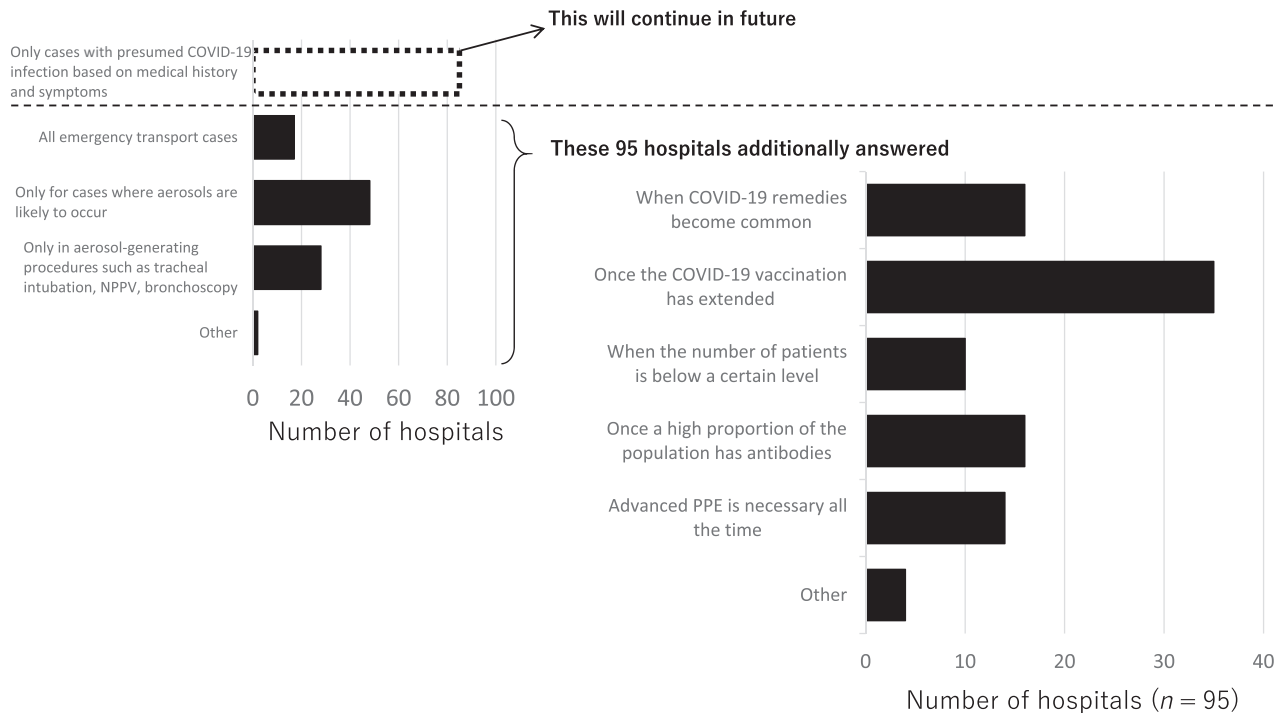


Fig. 8. Types of emergency patients whose medical care requires the use of advanced personal protective equipment (PPE) during initial treatment, now and in the future. NPPV, non-invasive positive pressure ventilation.

were discharged or died, the mortality rate of COVID-19 in this study was 4.5% of all hospitalized patients and 14% in ICU patients; however, this study is limited as no detailed patient information is available.

Most hospitals suffered from lack of medical equipment, similar to other countries⁷. More than half of the flagship hospitals could provide only one N95 mask every 2 or more days. Moreover, in medical institutions designated for specified infectious diseases, shortages of N95 masks and other equipment occurred, even though these hospitals are designated by the Minister of Health, Labour and Welfare of Japan or a prefectural governor, and are preferentially supplied with medical equipment for infectious diseases in peacetime. A survey of ICU clinicians in the USA reported that shortages of PPE masks for medical staff were the most common issue.⁷ The majority of hospitals worked diligently to ensure availability of medical supplies and PPE. After a quantity of the equipment was secured, some hospitals became concerned about the quality of the equipment. Some hospitals lacked the disposable batteries needed for video laryngoscopes, which can be used on emergency patients after COVID-19 because they lower the risk of infection by aerosol transmission.⁸

In Japan, acute medicine physicians work not only as emergency physicians and critical care physicians, but also as acute care surgery physicians and intensivists during acute phases. They are also involved in directing the medical control system. Thus, acute medicine doctors cover a wider field. In this survey, as reported by more than 100 hospitals, the advantages of having acute medicine doctors during the first wave of COVID-19 were: familiar with judging urgency, management of patients with presumed infection, response to crisis, collaboration with other departments, coordinating care inside and outside hospital, and a mindset of contributing to society. Many acute medicine physicians assisted regional governmental agencies as advisors and volunteer coordinators. As this was a short-term survey, the response rate was below 40%. However, this study obtained widespread responses from 43 prefectures (all except Akita, Ehime, Niigata, and Toyama) and each category of hospital was well-represented, so we consider this study reflects the conditions across the country.

In this nationwide survey, among patients who were discharged or died, the mortality rate of COVID-19 in this study was 4.1% of all hospitalized patients and 12.5% in severe patients, which means one of eight severe patients

died. Medical staff suffered from PPE shortages. Restriction of ICU admissions, elective surgeries, and non-COVID-19 emergency patients (regardless of the number of accepted COVID-19 patients) occurred. However, the data of this survey showing that hospitals with dedicated COVID-19 ICUs accepted more patients with severe COVID-19 and had lower ICU admission restrictions could be helpful as a strategy in the next pandemic.

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DISCLOSURE

APPROVAL OF THE research protocol: Approved by the board members of JAAM.

Informed consent: N/A.

Registry and the registration no. of the study/trial: N/A.

Animal studies: N/A.

Conflict of interest: None.

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SUPPORTING INFORMATION

Additional Supporting Information may be found in the online version of this article at the publisher's web-site:

Appendix S1:

Flagship hospitals with acute medical centers that cooperated in this nationwide survey.