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ORIGINAL ARTICLE

Incidence and outcome of patients with difficulty in hospital acceptance during COVID-19 pandemic in Osaka Prefecture, Japan: A population-based descriptive study

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Abstract

Aim: The impact of the coronavirus disease (COVID-19) pandemic on the emergency medical service system in Japan has not been fully revealed. The purpose of this study was to determine the impact of the COVID-19 pandemic in 2021 on the difficulty in hospital acceptance of patients and patient outcome in Osaka Prefecture.

Methods: This study was a descriptive epidemiological study with a 3-year study period from January 2019 to December 2021. We included patients who were transported by ambulance and had registered in the Osaka Emergency Information Research Intelligent Operation Network (ORION) system. The primary end-point of this study was the difficulty in hospital acceptance by month, and the secondary outcome was the mortality of patients who experience difficulty in hospital acceptance in each year.

Results: We included 1,302,646 cases in this study. The proportion of cases with difficulty in hospital acceptance was 2.74% (12,829/468,709) in 2019, 3.74% (15,527/414,987) in 2020, and 5.09% (21,311/418,950) in 2021. The crude odds ratio for 2020 was 1.38 (95% confidence interval, 1.35–1.41) and for 2021 was 1.90 (95% confidence interval, 1.86–1.95). In 2019, 218 patients with difficulty in hospital acceptance had died by 21 days after hospitalization, whereas the number increased to 405 in 2020 and 750 in 2021.

Conclusion: The number of patients experiencing difficulty in hospital acceptance during the COVID-19 pandemic in Osaka Prefecture increased, and patient outcomes were worse than before the pandemic.

KEYWORDS
COVID-19, difficulty in hospital acceptance, emergency medicine, excess deaths, public health

INTRODUCTION

To improve the prognosis of patients with sudden illness or trauma, it is necessary to transport them to appropriate emergency medical institutions within a reasonable time. In Japan, the health-care system is operated under public health-care insurance, and the emergency medical service (EMS) system, which includes calling for an ambulance, is a public service. After an ambulance is dispatched, the EMS personnel at the scene evaluate the patient, search for an appropriate medical institution for the patient with an information system, and request the medical institution to accept

the patient, basically by telephone. The doctor at the medical institution determines the patient's condition based on the phone call from the EMS personnel and decides whether to accept the patient. Until recently, the difficulty in hospital acceptance has been a social problem in Japan due to the increase in the elderly population,[1] but in recent years, this problem has been improved using technology systems such as cellphone applications (apps).[2]

The novel coronavirus disease (COVID-19) confirmed in Wuhan, China, in December 2019 has spread not only in China but throughout the world.[3–12] In Japan, the number of patients with COVID-19 exceeded 1.7 million as of December 31, 2021.[13] As the numbers increased, especially in the United States and European countries, the number of health-care workers infected with COVID-19 also increased, leading to a crisis situation in health-care systems such as emergency medicine and intensive care.[14–19] After the spread of the COVID-19 pandemic in Japan, patients with fever visited specific medical institutions that could treat COVID-19 infection and received a diagnosis and treatment for this infection. However, on holidays and at night when these medical institutions are not fully staffed, patients with a sudden onset of fever call for an ambulance and are transported to selected emergency medical institutions that provide treatment for COVID-19. Many of these institutions to which the patients are transported include critical care centers that treat severely ill patients, such as those with severe trauma and out-of-hospital cardiac arrest. As a result, an excessive burden was placed on emergency medical institutions that treat highly urgent and severely ill patients, but the impact on the difficulty in hospital acceptance in Japan is unclear.

Osaka Prefecture is the largest metropolitan area in western Japan, with a population of 8.8 million people and approximately 500,000 calls for ambulances each year.[20] Since the first patient with COVID-19 was identified in Osaka Prefecture on January 23, 2020, the cumulative number of COVID-19 patients in Osaka Prefecture as of December 31, 2021 was 203,790.[21] We have previously revealed the impact of the spread of COVID-19 in 2020 on the EMS system and outcome of patients transported by ambulance.[22,23] However, in Japan, there was a marked increase in the number of COVID-19 patients in 2021 compared to 2020, which might have had a further impact. Therefore, the purpose of this study was to determine the impact of the COVID-19 pandemic in 2021 on the difficulty in hospital acceptance and patient outcome in Osaka Prefecture.

METHODS

Study design and settings

This was a retrospective observational study with a study period from January 1, 2019 to December 31, 2021. We included patients who were transported by ambulance using the cleaned data that was recorded in the Osaka Emergency Information Research Intelligent Operation Network (ORION) system in this study. Therefore, we excluded patients who were not registered in the ORION system and those with missing data.

In 2015, 8,839,469 people lived in the 1905 km^2 area of Osaka Prefecture.[20] Of them, 4,256,049 people (48.2%) were male and 2,278,324 people (25.8%) were elderly, aged 65 years old or more.[20] Because the ORION data is anonymized without specific personal data, such as patient name, date of birth, and address, the requirement of obtaining patient informed consent was waived. This study was approved by the Ethics Committee of Osaka University Graduate School of Medicine. This manuscript was written based on the STROBE statement to assess the reporting of cohort and cross-sectional studies.[24] The EMS system and hospitals in Osaka Prefecture and the ORION system are described in File S1.

Data collection and quality control

The ORION system checks for errors in the inputted in-hospital data, and the staff of each emergency hospital can correct them, if necessary. Through these tasks, cellphone app data, ambulance records, and the in-hospital data such as diagnosis and prognosis can be comprehensively registered for each patient transported by an ambulance. The registered data is cleaned by the Working Group to analyze the EMS system in Osaka Prefecture.[25] Among the collected and cleaned data, we excluded inconsistent data that did not contain all of the cellphone app data, ambulance records, and in-hospital data such as diagnosis and prognosis. In addition, we also excluded patients whose sex as registered by the fire department did not match that registered by the hospital or whose sex was missing. We also excluded patients whose age input by the fire department and that by the hospital differed by 3 years or more. When this difference was present, we defined the age input by the hospital as the patient's true age.

End-point

The primary end-point of this study was the difficulty in hospital acceptance for each month. Difficulty in hospital acceptance was defined as cases for which the number of phone calls required to determine which medical institution to transport the patient to was more than four and the time interval from arrival at the scene to departure from the scene was more than 30 min, based on the national standards.[26] The secondary outcome was the mortality of patients who experienced difficulty in hospital acceptance in each year. The number of patients experiencing difficulty in hospital acceptance and their mortality were calculated using the ORION dataset. The primary diagnosis of the deceased patients was classified according to the International Classification of Diseases 10th Revision (ICD-10).

Statistical analysis

First, the number of patients transported by ambulance and the difficulty in hospital acceptance were calculated on a monthly basis for each year. To evaluate the impact of COVID-19 on the difficulty in hospital acceptance, we calculated the crude odds ratio (OR) and 95% confidence interval (CI) using the dataset in 2019 as the reference year. We also assessed the difficulty in hospital acceptance in 2018 similarly with respect to 2019 in order to reveal prepandemic trends.

Next, the mortality outcome was evaluated in terms of death in the emergency department, and that among hospitalized patients was evaluated at 21 days after admission. In addition, subgroup analysis was carried out on patients transported by ambulance due to "acute disease" or "traffic accident" as the reason for the ambulance call. Crude OR and 95% CI values were calculated in the same way. Statistical analyses were implemented using Stata version 16.0MP (StataCorp).

RESULTS

Figure 1 shows the patient flow in this study. 2,411,552 cases (2018: 616,748; 2019: 635,201; 2020: 583,321; 2021: 576,282) were registered in the ORION database from 2019 to 2021. After data cleaning and excluding interhospital transfer cases, 1,797,351 (2018: 492,705; 2019: 468,709; 2020: 414,987; 2021: 418,950) cases were included in this study.

Table 1 shows the number of patients experiencing difficulty in hospital acceptance and the crude OR and 95% CI values in 2018, 2019, 2020, and 2021. The proportion of difficulty in hospital acceptance was 2.97% (13,745/462,773) in 2018, 2.74% (12,829/468,709) in 2019, 3.74% (15,527/414,987) in 2020, and 5.09% (21,311/418,950) in 2021. The crude OR for 2018 was 1.09 (1.06–1.11), for 2020 was 1.38 (95% CI, 1.35–1.41) and for 2021 was 1.90 (95% CI, 1.86–1.95). Figure S1 shows chronological change of number of patients and difficulty in hospital acceptance during the study period.

Table 2 shows the number of patients experiencing difficulty in hospital acceptance and the crude OR among them due to "acute disease". The proportion of difficulty in hospital acceptance was 2.43% (8292/340,665) in 2019, 3.66% (11,009/300,502) in 2020, and 5.10% (15,580/305,611) in 2021. The crude OR for 2020 was 1.52 (95% CI, 1.48–1.57) and for 2021 was 2.15 (95% CI, 2.10–2.21). Figure S2 shows the chronological change of number of patients and difficulty in hospital acceptance among "acute disease" cases during the study period.

Table 3 shows the number of patients experiencing difficulty in hospital acceptance and the crude OR among them due to "traffic accident". The proportion of difficulty in hospital acceptance was 2.58% (935/36,199) in 2019, 2.85% (888/31,134) in 2020, and 3.64% (1137/31,250) in 2021. The crude OR for 2020 was 1.11 (95% CI, 1.04–1.22) and for 2021 was 1.42 (95% CI, 1.30–1.56). Figure S3 shows the chronological change of the number of patients and difficulty in hospital acceptance among "traffic accident" cases during the study period.

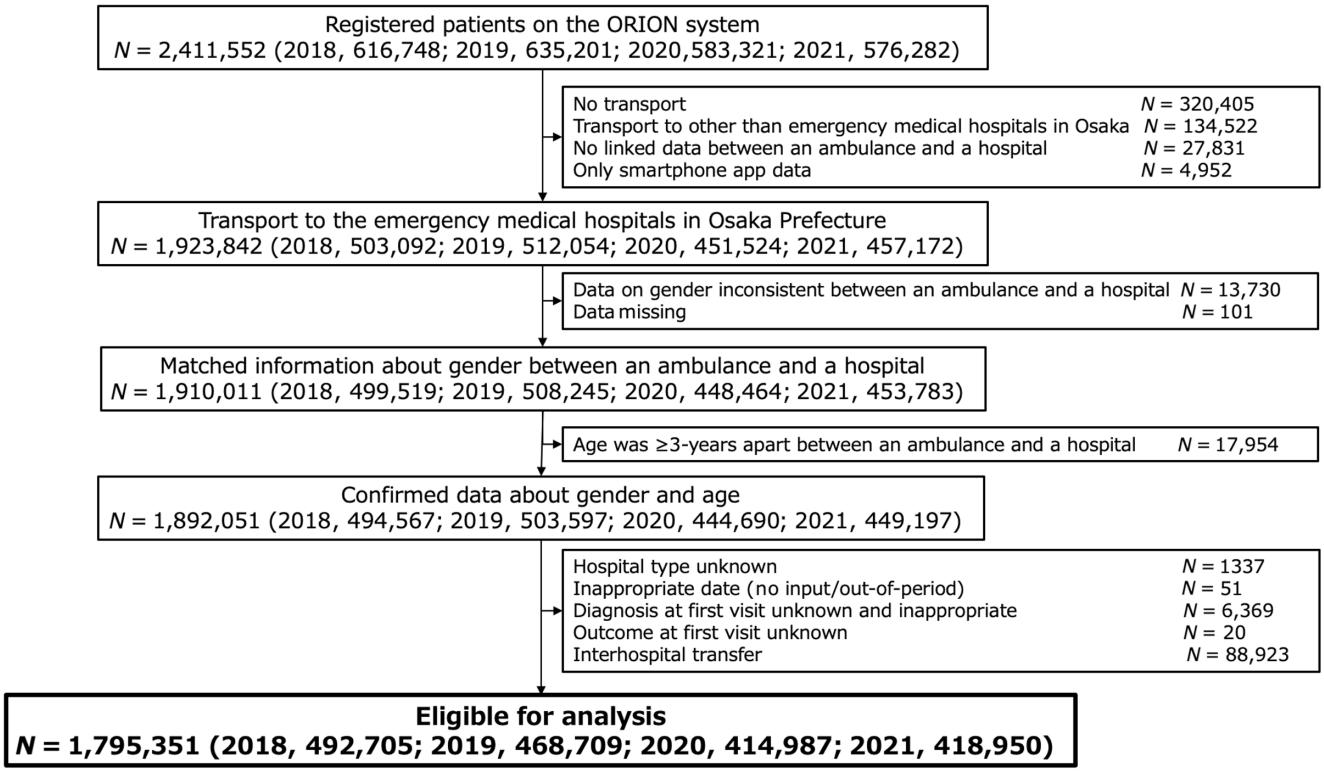

FIGURE 1 Patient flow in this study. ORION, Osaka Emergency Information Research Intelligent Operation Network.

TABLE 1 Proportion of difficulty in hospital acceptance of patients transported by ambulance in Osaka Prefecture, Japan, during the study periods.

	2018	2019	2020	2021	OR (95% CI)	OR (95% CI)	OR (95% CI)
	% (*n*/*N*)	% (*n*/*N*)	% (*n*/*N*)	% (*n*/*N*)	2018 vs. 2019	2019 vs. 2020	2019 vs. 2021
Jan	4.92 (2114/42,997)	4.40 (1982/45,012)	3.25 (1345/41,435)	6.60 (2293/34,767)	1.12 (1.05–1.20)	0.73 (0.68–0.78)	1.53 (1.44–1.63)
Feb	5.59 (2020/36,109)	3.70 (1292/34,958)	2.96 (1045/35,342)	5.46 (1646/30,145)	1.54 (1.44–1.66)	0.79 (0.73–0.86)	1.50 (1.40–1.62)
Mar	3.59 (1281/35,678)	3.12 (1156/36,996)	3.24 (1092/33,671)	4.45 (1543/34,698)	1.15 (1.06–1.25)	1.04 (0.95–1.13)	1.44 (1.33–1.56)
Apr	2.69 (921/34,270)	2.82 (1046/37,110)	5.24 (1519/28,974)	7.15 (2352/32,911)	0.95 (0.87–1.04)	1.91 (1.76–2.07)	2.65 (2.46–2.86)
May	2.30 (816/35,440)	2.62 (993/37,857)	4.56 (1363/29,885)	7.11 (2249/31,645)	0.87 (0.80–0.96)	1.77 (1.63–1.93)	2.84 (2.63–3.07)
Jun	2.06 (738/35,873)	2.28 (847/37,123)	2.33 (754/32,375)	3.78 (1244/32,929)	0.90 (0.81–1.00)	1.02 (0.92–1.13)	1.68 (1.54–1.84)
Jul	2.44 (1143/46,837)	2.13 (860/40,421)	2.96 (1054/35,560)	4.00 (1540/38,479)	1.15 (1.05–1.26)	1.41 (1.28–1.54)	1.92 (1.76–2.09)
Aug	2.42 (1029/42,583)	2.41 (1059/43,874)	4.69 (1899/40,474)	5.54 (2095/37,785)	1.00 (0.92–1.09)	1.99 (1.84–2.15)	2.37 (2.20–2.56)
Sep	2.50 (950/37,946)	2.14 (825/38,553)	3.49 (1196/34,311)	5.75 (1932/33,617)	1.17 (1.07–1.29)	1.65 (1.51–1.81)	2.79 (2.56–3.03)
Oct	2.25 (846/37,566)	2.23 (845/37,839)	3.00 (1048/34,986)	4.02 (1475/36,710)	1.01 (0.91–1.11)	1.35 (1.23–1.48)	1.83 (1.68–2.00)
Nov	2.24 (824/36,755)	2.34 (880/37,635)	4.06 (1354/33,340)	3.84 (1376/35,861)	0.96 (0.87–1.06)	1.77 (1.62–1.93)	1.67 (1.53–1.82)
Dec	2.61 (1063/40,719)	2.53 (1044/41,331)	5.36 (1858/34,634)	3.97 (1566/39,403)	1.03 (0.95–1.13)	2.19 (2.02–2.36)	1.60 (1.47–1.73)
Total	2.97 (13,745/462,773)	2.74 (12,829/468,709)	3.74 (15,527/414,987)	5.09 (21,311/418,950)	1.09 (1.06–1.11)	1.38 (1.35–1.41)	1.90 (1.86–1.95)

Note: 2019 is the reference year.

Abbreviations: CI, confidence interval; OR, odds ratio.

Figure 2 shows the primary diagnoses of the patients dying in the emergency department among the patients with difficulty in hospital acceptance. In 2019, before the COVID-19 pandemic, 13 patients died in the emergency department, but the number increased to 19 in 2020 and to 39 in 2021. In 2019, "diseases of respiratory system" was the most common primary diagnosis ($n=5$), but "diseases of circulatory system" was the most common primary diagnosis in 2020 ($n=8$) and in 2021 ($n=21$).

Figure 3 shows the primary diagnoses of the patients who had died at 21 days among the hospitalized patients in each year. In 2019, before the COVID-19 pandemic, 218 patients with difficulty in hospital acceptance were dead at 21 days after hospitalization, whereas the number increased to 405 in 2020 and 750 in 2021. In terms of diagnoses, deaths increased in all conditions compared to those before the COVID-19 pandemic, especially for "certain infectious and parasitic diseases" and "diseases of respiratory system". The number of patients dying due to COVID-19 was 18 in 2020 and 59 in 2021.

DISCUSSION

This study revealed the patient characteristics and outcomes of patients experiencing difficulty in hospital acceptance during the COVID-19 pandemic in Japan. The number of cases with difficulty in hospital acceptance increased in 2020 compared to 2019 and further increased in 2021. The number of deaths among patients with difficulty in hospital acceptance increased in the emergency departments, and it also increased among hospitalized patients after emergency transport. The number of deaths among hospitalized patients increased for all conditions, especially respiratory and cardiovascular diseases. In addition, there are some patients with COVID-19 among the cases with difficulty in hospital acceptance. This study, which revealed the impact of the spread of an emerging infectious disease on the EMS system through a population-based dataset, will be helpful in planning health-care systems and policies.

First, the number of patients transported by ambulance in 2021 was similar to that in 2020 and decreased compared to the prepandemic period of COVID-19. However, the number of cases with difficulty in hospital acceptance increased in 2020 and 2021. In our previous study on the factors associated with difficulty in hospital acceptance, we found that factors such as elderly patients, foreign patients, holiday with weekends, and night-time were associated with difficult acceptance.[1] After the COVID-19 pandemic in 2020, the number of foreigners visiting Japan also decreased markedly due to strict restrictions on travelers between many countries.[27] Therefore, the impact of patient factors related to difficulty in hospital acceptance might be rather low. Nevertheless, the increase in the number of cases with difficulty in hospital acceptance could have been attributed to factors related to medical institutions, such as limited patient capacity. Several factors were associated with this

TABLE 2 Proportion of difficulty in hospital acceptance of patients with acute disease transported by ambulance in Osaka Prefecture, Japan, during the study periods.

	2019	2020	2021	OR (95% CI)	OR (95% CI)
Month	% (*n*/*N*)	% (*n*/*N*)	% (*n*/*N*)	2019 vs. 2020	2019 vs. 2021
Jan	4.20 (1437/34,249)	2.97 (915/30,857)	6.98 (1764/25,283)	0.70 (0.64–0.76)	1.71 (1.59–1.84)
Feb	3.33 (858/25,757)	2.60 (666/25,663)	5.37 (1165/21,683)	0.77 (0.70–0.86)	1.65 (1.50–1.80)
Mar	2.75 (730/26,544)	2.97 (719/24,224)	4.21 (1052/25,002)	1.08 (0.97–1.20)	1.55 (1.41–1.71)
Apr	2.50 (660/26,370)	5.69 (1215/21,363)	7.83 (1900/24,280)	2.35 (2.13–2.59)	3.31 (3.02–2.62)
May	2.31 (636/27,524)	4.77 (1037/21,760)	7.51 (1774/23,620)	2.12 (1.91–2.34)	3.43 (3.13–3.77)
Jun	1.87 (506/27,131)	2.19 (508/23,247)	3.66 (888/24,286)	1.18 (1.04–1.33)	2.00 (1.79–2.23)
Jul	1.91 (564/29,555)	2.90 (743/25,619)	3.77 (1082/28,665)	1.54 (1.37–1.72)	2.02 (1.82–2.24)
Aug	2.17 (714/32,882)	4.68 (1434/30,656)	5.60 (1613/28,821)	2.21 (2.02–2.42)	2.67 (2.44–2.92)
Sep	1.86 (520/27,935)	3.28 (813/24,781)	5.79 (1456/25,163)	1.79 (1.60–2.00)	3.24 (2.92–3.59)
Oct	1.84 (491/26,681)	2.81 (687/24,418)	3.83 (998/26,088)	1.54 (1.37–1.74)	2.12 (1.90–2.37)
Nov	2.00 (530/26,538)	3.94 (929/235,639	3.55 (897/25,236)	2.01 (1.81–2.25)	1.81 (1.62–2.02)
Dec	2.19 (646/29,499)	5.52 (1343/24,351)	3.61 (991/27,484)	2.61 (2.37–2.87)	1.67 (1.51–1.85)
Total	2.43 (8292/340,665)	3.66 (11,009/300,502)	5.10 (15,580/305,611)	1.52 (1.48–1.57)	2.15 (2.10–2.21)

Abbreviations: CI, confidence interval; OR, odds ratio.

TABLE 3 Proportion of difficulty in hospital acceptance of patients in traffic accidents transported by ambulance during the study periods.

	2019	2020	2021	OR (95% CI)	OR (95% CI)
Month	% (*n*/*N*)	% (*n*/*N*)	% (*n*/*N*)	2019 vs. 2020	2019 vs. 2021
Jan	3.85 (101/2620)	2.58 (68/2635)	4.20 (100/2379)	0.66 (0.48–0.91)	1.09 (0.82–1.47)
Feb	2.47 (62/2510)	2.68 (69/2578)	4.08 (94/2303)	1.09 (0.76–1.56)	1.68 (1.20–2.37)
Mar	3.00 (90/2997)	2.91 (78/2679)	3.28 (85/2590)	0.97 (0.70–1.33)	1.10 (0.80–1.50)
Apr	3.05 (99/3248)	1.96 (37/1891)	3.77 (92/2442)	0.63 (0.42–0.94)	1.25 (0.92–1.68)
May	2.15 (65/3024)	3.01 (64/2127)	3.79 (84/2219)	1.41 (0.98–2.04)	1.79 (1.27–2.53)
Jun	2.71 (78/2878)	2.18 (58/2658)	2.82 (74/2625)	0.80 (0.56–1.32)	1.04 (0.74–1.46)
Jul	2.28 (73/3198)	2.11 (60/2843)	3.02 (85/2814)	0.92 (0.64–1.32)	1.33 (0.96–1.86)
Aug	2.25 (69/3068)	3.45 (93/2695)	4.63 (116/2505)	1.55 (1.12–2.16)	2.11 (1.54–2.90)
Sep	1.99 (61/3067)	2.88 (77/2678)	4.40 (107/2432)	1.46 (1.02–2.08)	2.27 (1.63–3.17)
Oct	2.25 (72/3207)	2.38 (67/2820)	3.73 (110/2952)	1.06 (0.75–1.51)	1.69 (1.23–2.31)
Nov	2.85 (92/3223)	3.69 (100/2712)	3.06 (86/2812)	1.30 (0.97–1.76)	1.07 (0.79–1.46)
Dec	2.31 (73/3159)	4.15 (117/2818)	3.27 (104/3177)	1.83 (1.35–2.50)	1.43 (1.05–1.97)
Total	2.58 (935/36,199)	2.85 (888/31,134)	3.64 (1137/31,250)	1.11 (1.01–1.22)	1.42 (1.30–1.56)

Abbreviations: CI, confidence interval; OR, odds ratio.

result. First, in the early stages of the COVID-19 pandemic, the best possible infection control measures were taken because the toxicity of COVID-19 and the infection route were unknown. In addition, there was not only a shortage of personal protective equipment to protect health-care workers, but it was also necessary to secure specialized outpatient and clinic space at medical institutions with extensive infection prevention measures. Many of these institutions are public medical institutions and university hospitals and also constitute the emergency medical care system. As these medical institutions were also responsible for COVID-19 care, many of them might not have been able to adequately accept patients transported to emergency rooms.

Second, even at medical institutions with well-developed infection prevention measures, when an outbreak of COVID-19 infection occurred among medical staff or hospitalized patients, the public health department requested that medical care be suspended for a certain period. This may have reduced the number of medical institutions that could accept patients, resulting in yet more difficulty in hospital acceptance. Furthermore, as of 2021, the availability and quantity of COVID-19 vaccines were insufficient in Japan compared to European countries and the United States. In addition, because the vaccine was approved on an emergency basis, there was insufficient understanding of the vaccine among the public in Japan. In 2022, the COVID-19

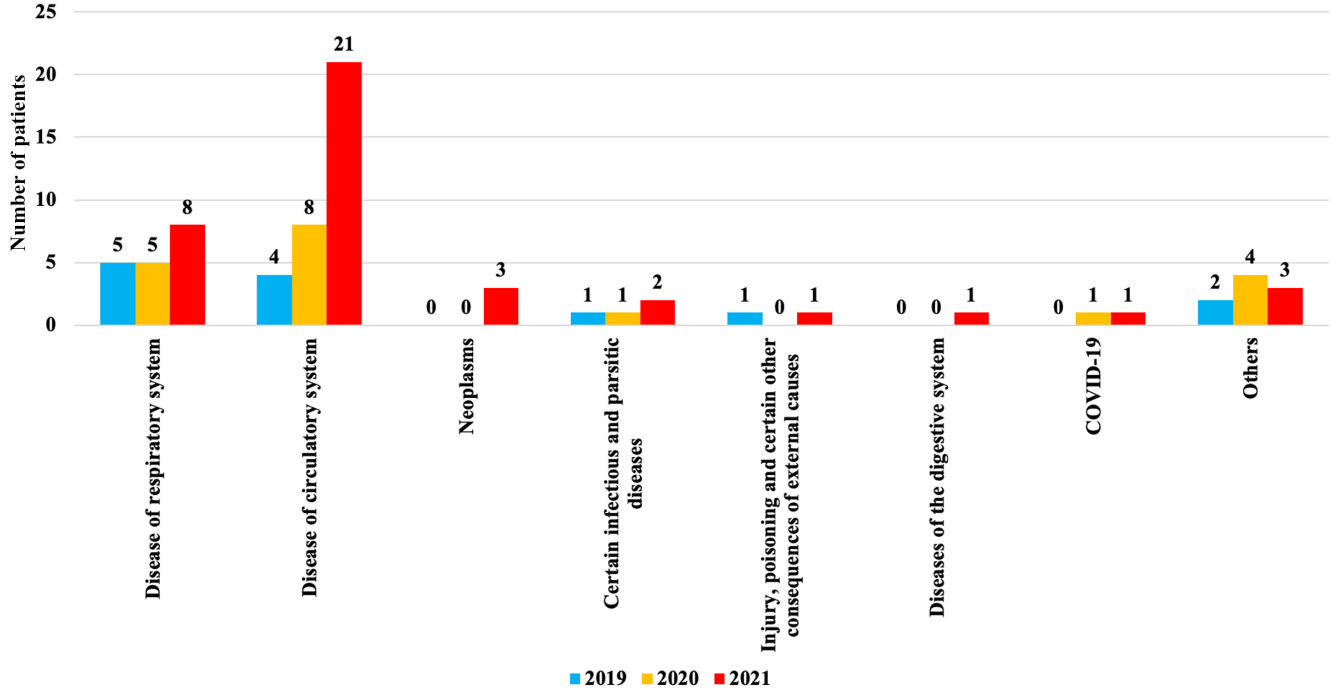

FIGURE 2 Primary diagnoses of the patients who died in the emergency department among the patients with difficulty in hospital acceptance in Osaka Prefecture, Japan.

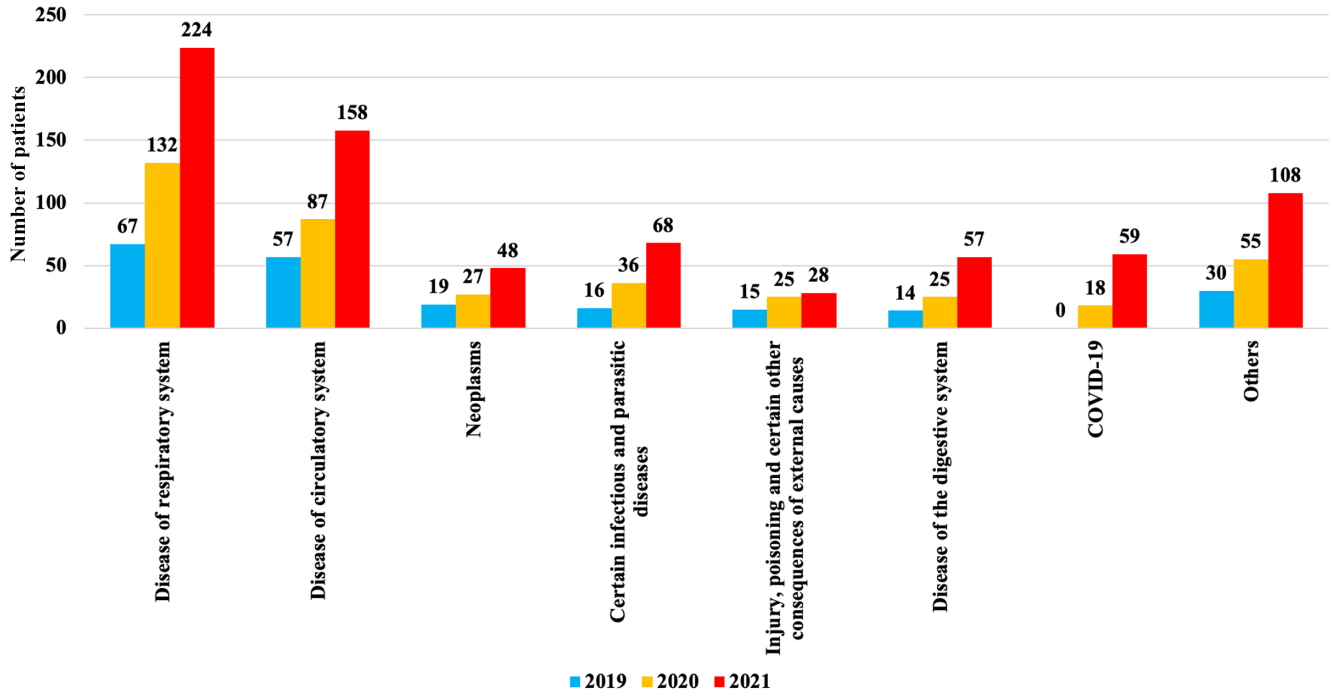

FIGURE 3 Primary diagnoses of the patients who had died at 21 days among the hospitalized patients in each year in Osaka Prefecture, Japan.

vaccine was sufficiently widespread in Japan, and we will assess in the future whether the widespread use of these vaccines contributed to improvement of the difficulty in hospital acceptance.

Third, the level of difficulty in hospital acceptance for acute disease did not return to the prepandemic level before COVID-19, whereas that for traffic accident patients did return to the prepandemic level of COVID-19 during the period when the number of COVID-19 patients did not increase in 2020–2021. In our previous study of the first wave of the COVID-19 pandemic from January to April in 2020, the number of patients with difficulty in hospital

acceptance among those with acute disease increased but that among traffic accident patients did not increase.[22] Several factors might have contributed to this result. First, COVID-19 was designated as a category 2 infection under the Infectious Disease Control Law in Japan,[28] and COVID-19 patients are now treated at special medical institutions. However, the chief complaints and symptoms of COVID-19, such as fever and sore throat, are signs and symptoms common to other diseases. The number of patients with these signs and symptoms in whom COVID-19 infection could not be ruled out were concentrated in specific medical institutions, which probably resulted in an increase in the number of cases with difficulty in hospital acceptance. As antigen tests and polymerase chain reaction tests for COVID-19 became more widely available, some medical institutions took action to carry out these tests on patients in the ambulance prior to treatment, denying admission of patients with COVID-19 and sending them to other hospitals. However, this did not improve the difficulty in hospital acceptance in 2021. In Japan, EMS personnel at the scene select appropriate medical institutions for patients and transport them. To solve this problem, it will be necessary to expand the activities of EMS personnel so that they can undertake COVID-19 antigen testing in the ambulance. Second, patients infected with COVID-19 are restricted from going to work based on the Infection Disease Control Law in Japan.[29] Therefore, when medical staff were infected with COVID-19, they were restricted from working based not only on the Law but also on each hospital's guidelines regarding COVID-19, which resulted in many medical institutions being closed because they could not secure the necessary medical staff. This probably led to a decrease in the number of medical institutions that could accommodate patients and an increase in the number of cases with difficulty in hospital acceptance. In contrast, the level of difficulty in hospital acceptance due to traffic accidents was similar to that before the COVID-19 pandemic in some periods. In the early phase of the COVID-19 pandemic, the number of cases with difficulty in hospital acceptance due to traffic accidents did not increase despite the limitation of medical institutions, probably because traffic accidents decreased due to limitations on social activities caused by the urban lockdown.[22] In 2021, the usual socioeconomic activities were not restricted, which may have limited the medical services that could be provided to patients in traffic accidents when the number of patients with COVID-19 increased and medical institutions were under pressure. In Japan, the national and local governments do not have the authority to compel medical institutions to accept or treat patients. Therefore, it is up to medical institutions to decide whether or not to treat patients, which could have caused the difficulty in hospital acceptance during the COVID-19 pandemic. In order to prepare for future pandemics, it is necessary to discuss legal authority over the medical system.

Finally, both the number of deaths in the emergency department and that among the hospitalized patients were increased in the cases with difficulty in hospital acceptance. Several studies have reported that the COVID-19 pandemic affected patient outcome.[16,30,31] Surek et al. revealed that while hospitalizations for acute cholecystitis and uncomplicated appendicitis were markedly reduced during the COVID-19 pandemic, hospitalizations for complicated appendicitis and acute mechanical intestinal obstruction were increased, and the mortality from emergency surgery also increased.[30] A study of out-of-hospital cardiopulmonary arrest (OHCA) in South Korea found that the time from arrival at the scene to the start of activities by EMS personnel and transport time were increased by the increased requirement for personal protective equipment in the prehospital situation and by securing isolation wards.[31] A study in Japan also found that the rate of bystander cardiopulmonary resuscitation was decreased for OHCA patients during the COVID-19 pandemic.[16] Thus, factors such as delay in patient access to medical care associated with the COVID-19 pandemic, decreased treatment performance of health-care staff due to infection protection, and lower rates of prehospital first aid implementation could have affected patient outcomes. In the subgroup analysis there was an increase in deaths from all conditions, but especially those of respiratory diseases and infections. The Surviving Sepsis Campaign Guidelines in 2020 state that early intervention in the treatment of sepsis contributes to patient prognosis.[32] In addition, patients with infectious diseases and respiratory diseases cannot be distinguished from COVID-19 patients because they are evaluated in the prehospital situation with chief complaints such as fever and dyspnea. Therefore, it is likely that transport requests for not only COVID-19 patients but also patients with severe infections and respiratory diseases were concentrated at medical institutions that could treat COVID-19 patients. As a result, many of these patients might have experienced a delay before treatment intervention that could have affected their prognosis. In Japan, emergency life-saving technicians (ELSTs) are not legally allowed to use test kits to determine COVID-19 infection. To prepare for the spread of unknown infectious diseases in the future, ELSTs could be allowed to use test kits for patients suspected of having infectious diseases such as influenza and COVID-19.

Limitations

There are several limitations in this study. First, this study was designed to evaluate the acceptance of patients by medical institutions and the selection of medical institutions by the EMS personnel at the scene, so it was not possible to evaluate the interhospital transfer cases. Second, because the ORION registry we used in this study registers patient data from all fire departments and medical institutions in Osaka Prefecture, the prognosis of patients taken to medical institutions outside Osaka Prefecture or transported by fire departments outside Osaka Prefecture is unknown. Finally,

because this is an observational study, there are unknown confounding factors.

CONCLUSION

The number of patients with difficulty in hospital acceptance during the COVID-19 pandemic in Osaka Prefecture increased, and patient outcomes were worse than before the pandemic.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from Osaka Prefectural Government. Restrictions apply to the availability of these data, which were used under license for this study.

ETHICS STATEMENT

Approval of the research protocol: This study was approved by the Ethics Committee of Osaka University Graduate School of Medicine (approval no. 15003). The manuscript was written based on the STROBE statement to assess the reporting of cohort and cross-sectional studies. All methods in this study have been carried out in accordance with the Declaration of Helsinki.

Informed consent: ORION data are considered administrative records, and the ORION data are anonymized without specific personal data, such as patient name, date of birth, and address. Therefore, the requirement to obtain patient informed consent was waived.

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

Animal studies: N/A.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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