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Are hospitals with both medical/surgical and psychiatric services associated with decreased difficulty in ambulance transfer for patients with self-harm behaviour? A nationwide retrospective observational study using ambulance transfer data in Japan

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ABSTRACT

Objectives Ambulance diversion and prolonged prehospital transfer time have a significant impact on patient care outcomes. Self-harm behaviour in particular is associated with difficulty in hospital acceptance and longer prehospital transfer time. This study aimed to determine if hospitals with both medical/surgical and psychiatric inpatient beds and high-level emergency care centres are associated with a decreased rate of difficulty in hospital acceptance and shorter prehospital transfer time for patients seeking medical care after self-harm behaviour.

Design and setting A retrospective observational study using the database of Japanese ambulance dispatch data in 2015.

Participants Patients who were transferred by ambulances after self-harm behaviour.

Interventions None.

Main outcome measures Multivariable logistic regression analysis and multivariable linear regression analysis were performed to assess whether the presence of hospitals with both medical/surgical and psychiatric inpatient beds and high-level emergency care centres in the city were associated with a decreased rate of difficulty in hospital acceptance and shorter prehospital transfer time.

Results The number of transfers due to self-harm behaviour in 2015 was 32 849. There was an association between decreased difficulty in hospital acceptance and the presence of high-level emergency care centres (OR 0.63, 95% CI 0.55 to 0.71, p<0.01) and hospitals with both medical/surgical and psychiatric inpatient beds (OR 0.50, 95% CI 0.38 to 0.66, p<0.01). There was a significant reduction in prehospital transfer time in the city with high-level emergency care centres (4.21 min, 95% CI 3.53 to 4.89, p<0.01) and hospitals with medical/surgical and psychiatric inpatient beds (3.46 min, 95% CI 2.15 to 4.77, p<0.01).

Conclusion Hospitals with both medical/surgical and psychiatric inpatient beds and high-level emergency care centres were associated with significant decrease in difficulty in hospital acceptance and shorter prehospital transfer time.

STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ This study is a retrospective analysis of a nationwide database.
- ⇒ The database includes almost all the transfer data in Japan.
- ⇒ The retrospective nature of the study makes it difficult to draw causal relationships.
- ⇒ This result may not be applicable to other countries with different medical transfer systems.

INTRODUCTION

For the last 30 years, ambulance diversion has been a major issue since it was adopted as a measure to mitigate emergency department overcrowding.[1 2] Ambulance diversion was associated with increased mortality in patients with acute myocardial infarction, trauma and cardiac arrest.[3–6] Decreasing ambulance diversion and the time of emergency medical service transfer could have a significant clinical impact on patients' outcomes.

Suicide is one of the major causes of death in Japan,[7] and mental health issues are prevalent in patients who visit emergency departments.[8] While the community efforts to reduce the suicide rate decreased the number of suicidal death over the last 10 years,[9] recent studies showed that the rate of suicide and emergency department visits due to suicidal attempts are increasing possibly due to COVID-19 pandemic.[10 11] Ambulance

diversion in patients with self-harm behaviour has been an issue in Japan,[12] but effective ways to minimise ambulance diversion have not been fully established yet.

Factors associated with the increased ambulance diversion rate in patients seeking care after self-harm behaviour are not well studied. We presumed that the lack of mental health resources is a major obstacle for hospitals to accept patients with self-harm behaviour. In this study, we aimed to determine if the presence of hospitals with both medical/surgical and psychiatric inpatient beds (MSPHs) or high-level emergency care centres in the city is associated with decreased rate of difficulty in hospital acceptance at the scene and shorter prehospital transfer time for patients with self-harm behaviour.

METHODS

Emergency medicine system in Japan

The Emergency Medicine System (EMS) in Japan is run by local governments and available to everyone who needs emergency transport to a hospital without any direct payment. After an ambulance is called to pick up a patient, the EMS needs to find an accepting hospital that can provide optimal care in the area. With the exception of a few areas, such as Tokyo, there are no systematic regulations that prevent ambulance diversion and each hospital can decide to accept the patient based on capacity and capability. Sometimes multiple phone calls are required to find an accepting hospital.

Currently, there are 265 level-three emergency care centres (EC3s) (designated critical care hospitals) in Japan to accept severely ill or injured patients due to stroke, acute myocardial infarction, cardiopulmonary arrest, trauma, etc. A hospital must meet certain criteria to be appointed as an EC3. The availability of on-call psychiatrists is one of the evaluation items for the EC3 assessed by Ministry of Health, Labour, and Welfare. However, it is not a mandatory requirement and a lack of psychiatric service does not automatically indicate the loss of credentials for EC3. In this study, we defined high-level emergency care centres as EC3.

MSPHs have medical and surgical specialists for physical diseases as well as psychiatrists for psychiatric issues. However, medical resources at these facilities may be limited compared with EC3s.

Study design, population, and setting

This is a retrospective observational study using a Japanese national database of nationwide ambulance dispatches in 2015. The database does not include ambulance transfers in Tokyo, where a different database for EMS transfer is used. We collected cases of ambulance transfers due to self-harm behaviour. The Japanese Population Census performed in 2015 was used to collect data regarding municipal population. Static/Dynamic Surveys of Medical Institutions and Hospitals conducted by the Ministry of Health, Labor and Welfare in 2015 was referenced for the number of inpatient beds. The information about hospitals with medical and psychiatric inpatient beds was provided by Japanese Society of General Hospital Psychiatry.

Patient and public involvement

Patients and/or the public were not involved in the design, conduct, reporting, or dissemination plans of this research.

Data collection and quality control

A previous study using the same database has already described how the information was collected.[13] Data were collected uniformly using specific data collection forms which include age, gender, location of the call, time of the day, chronological factors such as time of the day or day of the week, time of ambulance request, time of arrival at the scene, time of arrival at the accepting hospital, diagnosis and severity. The forms were completed by

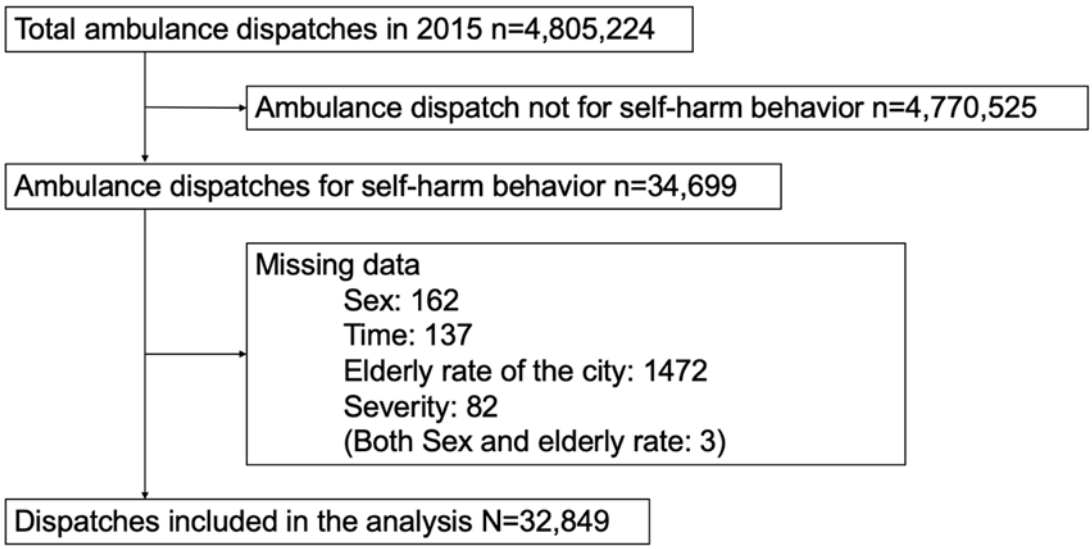

Figure 1 Patient flow.

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Table 1 Baseline characteristics

	All transfer (N=32 849)	Phone calls ≥ 4 times (N=2767)	Phone calls <4 times (N=30 082)	
Age (SD)	45.0 (19.1)	41.5 (17.1)	45.4 (19.1)	***
Female sex (%)	20 283 (61.6)	1912 (69.1)	18 319 (60.9)	***
Elderly rate (SD)	26.6 (4.0)	26.2 (3.4)	26.6 (4.1)	***
Population density in the city (SD)†	305.6 (339.6)	459.0 (427.8)	291.5 (326.7)	***
Hospital beds per capita in the city (SD)‡	132.3 (59.5)	120.4 (46.6)	133.4 (60.5)	***
Night-time transfer (%)	21 181 (64.5)	2027 (73.3)	19 154 (63.7)	***
Weekend/holiday transfer (%)	9692 (29.5)	883 (31.9)	8809 (29.3)	***
Severity (%)				
Mild	11 400 (34.7)	1150 (41.6)	10 250 (34.1)	***
Moderate	12 408 (37.8)	1288 (46.6)	11 120 (37.0)	
Severe	4893 (14.9)	192 (6.9)	4701 (15.6)	
Death	4148 (12.6)	137 (5.0)	4011 (13.3)	
Location (%)				
Home	26 463 (80.6)	2308 (83.4)	24 155 (80.3)	***
Public space	2743 (8.4)	194 (7.0)	2549 (8.5)	
Workplace	342 (1.0)	19 (0.7)	323 (1.1)	
Road	1267 (3.9)	109 (3.9)	1158 (3.9)	
Other	2034 (6.2)	137 (5.0)	1897 (6.3)	
Hospitals with medical/surgical and psychiatric wards (%)	14 823 (45.1)	1243 (44.9)	13 580 (45.1)	
Level-three emergency care centres (%)	20 387 (62.1)	1648 (59.6)	18 739 (62.3)	***
Hospitals with only psychiatric service (%)	26 992 (82.2)	2240 (81.0)	24 752 (82.3)	*
Emergency care centre (%)	32 292 (98.3)	2740 (99.1)	29 582 (98.2)	

***P<0.01, **p<0.05, *p<0.1.
†Population density unit=population/squire kilometre.
‡Hospital beds per capita unit=hospital beds/10 000 population.

EMS personnel and confirmed by peer EMS personnel to ensure data accuracy. The treating physicians provided information regarding the patient's diagnosis and severity in the emergency department. The definition of a 'severe condition' is intensive care unit admission and a 'moderate condition' is defined by hospital admission. Daytime is from 800 to 1700. A designated supervising officer at each fire station assures the completeness of transport data. The data was gathered from EMS administrative records collected by the fire department and not connected to a patient's medical chart.

Endpoints

The primary outcome is the rate of cases with difficulty in hospital acceptance as defined by four or more phone calls before deciding the facility to transfer the patient. Although there is no data to show worse clinical outcomes associated with four or more phone calls, we deployed this definition as it is used by Ministry of Internal Affairs and Communications in White Paper on Fire Service. The secondary outcome is prehospital transfer time defined by the time between the arrival at the scene and the hospital arrival.

Statistical analysis

Univariate analysis was performed between the groups of patients with and without difficulty in hospital acceptance regarding baseline demographics using t-tests for continuous variables and χ^2 tests for binominal variables. Similarly, univariate analysis was performed for prehospital transfer time regarding some baseline characteristics. Then, a multivariable logistic regression model was applied for the assessment of difficulty in hospital acceptance. A multivariable linear regression model was applied to analyse factors associated with the prehospital transfer time. Factors included in the analysis were age, sex (male or female), rate of elderly (65 years old or older), population density, time of the day (day or night), day of the week (weekday or weekend/holiday), severity (mild, moderate, severe, death), location (public space, workplace, street or other), the number of inpatient beds per population in the city, the third digit of the Municipal Code assigned by Ministry of Internal Affairs and Communications which indicated the size and function of the city, the time between the initial ambulance request call and the arrival at the scene, number of emergency care

Table 2 Prehospital transfer time (min)

Category		Transfer time (SD)	
All transfer		37.1 (22.8)	
Sex	Male	35.3 (22.7)	***
	Female	38.2 (22.8)	
Time	Night-time	38.1 (23.2)	***
	Day-time	35.3 (21.8)	
Severity	Mild	39.3 (22.2)	***
	Moderate	41.0 (25.0)	
	Severe	31.9 (20.8)	
	Death	25.5 (12.7)	
Level-three emergency care centres in the city	Presence	36.2 (21.9)	***
	Absence	38.5 (24.1)	
Hospitals with medical/surgical and psychiatric wards in the city	Presence	36.7 (22.5)	***
	Absence	37.5 (23.0)	
Hospitals with only psychiatric service in the city	Presence	36.8 (22.4)	***
	Absence	38.7 (24.4)	

***p<0.01

centres that are not EC3s, presence of hospitals with only psychiatric service in the city, the presence of MSPHs and EC3s. Interaction terms were adopted for the presence of MSPHs and EC3s. The presence of MSPHs, EC3s and hospitals with only psychiatry services, and the number of emergency care centres were assessed by the existence of them in the municipality where ambulance dispatch happened. Population density, the number of inpatient beds per population and elderly rate were calculated in each municipality. The third digit of the Municipal Code was used to classify municipalities into four groups: (1) Tokyo and 20 major government ordinance-designated cities, (2) cities without government ordinance-designation, (3) towns and villages that are smaller than cities and have fewer than 50 000 population and (4) smaller towns and villages that jointly run fire departments and EMS services. Transfer data with missing information were removed from the analysis. Hospital activities and ease of ambulance transfer may be affected by time (day-time vs night time) and day (weekday vs weekend/holiday); therefore, we performed subgroup analysis to explore if similar findings can be discovered across the different groups: night-time, day-time, weekday and weekend/holiday. Stata V.14 was utilised for statistical analysis. All tests were two-tailed, and p value <0.05 was considered statistically significant.

RESULTS

The number of total ambulance dispatches was 4 805 224, and ambulance transfers due to self-harm behaviour were 34 699. After excluding 1850 transfers with missing data, 32 849 cases were enrolled in the study(figure 1). The mean age was 45.0 years old and women account for 61.6% of transfers (table 1). Cases with difficulty in hospital acceptance were 8.4% in patients with self-harm behaviour, and 2.9% in those without self-harm behaviour. The average prehospital pretransfer time was 37.1 min (SD 22.8) in patients with self-harm behaviour (table 2) and 29.5 min (SD 14.9) in those without self-harm behaviour.

Table 3 is the result of multivariable logistic regression analysis for factors associated with difficulty in hospital acceptance. Table 4 is the result of multivariable linear regression analysis for prehospital transfer time. Full tables with other covariates included in the analysis are shown in online supplemental tables 1 and 2. MSPHs (OR) 0.50, 95% CI 0.38 to 0.66, p<0.01) and EC3s (OR 0.63, 95% CI 0.55 to 0.71, p<0.01) were associated with decreased difficulty in hospital acceptance after adjusting other factors with a multivariable regression model when the other was absent in the city. In terms of prehospital transfer time, MSPHs (−3.46 min, 95% CI −2.15 to −4.77,

Table 3 Multivariable logistic regression analysis for difficulty in hospital acceptance (OR)

	All	Night-time	Day-time	Weekend/holiday	Weekday
MSPHs	0.50*** (0.38 to 0.66)	0.51*** (0.37 to 0.70)	0.48*** (0.28 to 0.83)	0.57** (0.34 to 0.94)	0.47*** (0.34 to 0.65)
EC3s	0.63*** (0.55 to 0.71)	0.63*** (0.55 to 0.73)	0.61*** (0.49 to 0.77)	0.77** (0.62 to 0.95)	0.57*** (0.49 to 0.66)
Interaction terms (MSPH and EC3)	1.47** (1.07 to 2.01)	1.40* (0.97 to 2.03)	1.62 (0.87 to 3.01)	1.23 (0.69 to 2.20)	1.59** (1.09 to 2.33)
Observations	32 849	21 181	11 668	9692	23 157

95% CI in parentheses, ***p<0.01, **p<0.05, *p<0.1.
Covariates included in the analysis: presence of psychiatry only hospitals, time from dispatch to arrival at the scene, emergency care centre, age, sex, elderly rate, population density, time (day or night), day (weekday or weekend/holiday), severity (mild, moderate, severe or death), place (home, public place, work place, road or other), hospital beds per capita and the third digit of the Municipal Code assigned by Ministry of Internal Affairs and Communications
EC3s, emergency care centres; MSPHs, medical/surgical and psychiatric inpatient beds.

Table 4 Multivariable linear regression analysis for prehospital transfer time (min)

	All	Night-time	Day-time	Weekend/holiday	Weekday
MSPHs	−3.46*** (−4.77 to −2.15)	−2.76*** (−4.54 to −0.97)	−4.63*** (−6.39 to −2.88)	−3.20*** (−5.58 to −0.82)	−3.54*** (−5.12 to −1.97)
EC3s	−4.21*** (−4.89 to −3.53)	−4.38*** (−5.25 to −3.50)	−3.931*** (−5.01 to −2.86)	−3.83*** (−5.10 to −2.56)	−4.37*** (−5.18 to −3.57)
Interaction terms (MSPH and EC3)	3.11*** (1.66 to 4.57)	2.18** (0.22 to 4.13)	4.74*** (2.68 to 6.81)	3.69*** (0.98 to 6.40)	2.86*** (1.12 to 4.59)
Observations	32 849	21 181	11 668	9692	23 157

95% CI in parentheses, ***p<0.01, **p<0.05, *p<0.1.
Covariates included in the analysis: presence of psychiatry only hospitals, time from dispatch to arrival at the scene, emergency care centres, age, sex, elderly rate, population density, time (day or night), day (weekday or weekend/holiday), severity (mild, moderate, severe or death), place (home, public place, work place, road or other), hospital beds per capita and the third digit of the Municipal Code assigned by Ministry of Internal Affairs and Communications.
EC3, emergency care centre; MSPHs, medical/surgical and psychiatric inpatient beds.

p<0.01) and EC3s (−4.21 min, 95% CI −3.53 to −4.89, p<0.01) were associated with shorter prehospital transfer time when the other was absent in the city. When both MSPHs and EC3s were present, the OR of difficulty in hospital acceptance was 0.46 and prehospital transfer time was −4.56 min. Interaction terms between the presence of MSPHs and EC3s were also statistically significant, and, the ORs of the presence of MSPHs and EC3s on the difficulty in hospital acceptance was 0.74 and 0.93, respectively, when the other was present in the city. Prehospital transfer times were −1.10 min and −0.35 min with the presence of MSPHs and EC3s, respectively, when the other was present in the city.

In the subgroup analysis, MSPHs and EC3s were associated with less difficulty in hospital acceptance and shorter prehospital transfer time in all groups: night-time, daytime, weekday, and weekend/holiday.

DISCUSSION

This study analysed large-scale nationwide retrospective observational data recorded ambulance transfers in Japan. The data revealed that the presence of MSPHs and EC3s was associated with less difficulty in hospital acceptance and shorter prehospital transfer time.

A previous retrospective observational study revealed that self-harm is one of several factors associated with difficulty in hospital acceptance.[14] Other studies have suggested factors associated with difficulty in hospital acceptance in elderly and traffic accident patients. Older age, healthcare facility residents, night-time and weekend/holiday were associated with difficulty in hospital acceptance in the geriatric population.[15] Male sex, moderate to severe injury, night-time and weekend/holiday were related to difficulty in hospital acceptance in traffic accident patients.[16] This study showed risk factors associated with difficulty in hospital acceptance in patients with self-harm behaviour, which had not been well studied. Recognising these factors could facilitate our understanding of the nature of the problem and a possible solution in the future.

In this study, the presence of MSPHs and EC3s had the ORs of 0.5 and 0.63 for difficulty in hospital acceptance and were associated with 3.46 min and 4.21 min shorter prehospital transfer time when the other was absent in the city. Because of the lack of data, we cannot determine if this 3–4 min decrease in prehospital transfer time has any clinical significance. Patients who were admitted to hospitals affected by marathon events due to acute myocardial infarction or cardiac arrest were reported to have increased prehospital transfer time (4.4 min) and higher mortality.[6] In patients with cardiac arrest or who require immediate intervention, 4 min reduction may have clinical significance. However, the majority of patients in this study had mild (34.7%) or moderate (37.8%) severity and are unlikely to need time-sensitive intervention, therefore, the true clinical meaning of this transfer time reduction is unclear. Additionally, increased prehospital time and ambulance diversion in patients with self-harm behaviour affect not only the patients themselves but also other patients who need ambulances in the area due to decreased availability of ambulances. This side effect on patients without self-harm behaviour was not measured in the study.

Although the OR for difficulty in hospital acceptance was smaller and prehospital transfer time was shorter when both MSPHs and EC3s were present when compared with the transfers in the city with either MSPH or EC3, the effect does not seem to be synergistic. Regarding the interaction between MSPH and EC3, multiplicative interaction was 1.47 and additive interaction was 0.33 on difficulty in hospital acceptance. It is suggested that the effect of MSPH and EC3 was greater in the absence of the other. The ORs of difficulty in hospital acceptance were larger (0.74 and 0.93) and prehospital transfer time reductions were shorter (0.35 min and 1.10 min) for MSPHs and EC3s when the other was present. This phenomenon could be explained by the way accepting physicians think. When other facilities in the same city can treat patients with self-harm behaviour, physicians may not feel obligated to accept the patients. It may simply be due to

saturating effect. When there is a facility that can treat both physical and mental issues, the difficulty in hospital acceptance and prehospital transfer time may already be low and short enough and there may not be room for improvement by adding another. However, given the high rate of difficulty in hospital acceptance and long prehospital transfer time in patients with self-harm behaviour, we presume there are still opportunities for improvement in the prehospital system.

The number of non-level-three emergency care centres was associated with increased difficulty in hospital acceptance and longer prehospital transfer time. The presence of hospitals with only psychiatric services was not related to difficulty in hospital acceptance and prehospital transfer time. These results indicate that simply creating emergency care centres or psychiatric facilities will not solve the issue and there is a call for coordinating care between medical/surgical and psychiatric care. Recently, the number of general hospitals with psychiatric inpatient services has been decreasing in Japan,[17 18] which might negatively affect patients with both physical and psychiatric illnesses. We found that six EC3s without inpatient psychiatric units had opened new small-scale psychiatric inpatient units between 2013 and 2016 in an attempt to appropriately manage patients with both physical and mental problems. We need to closely monitor the effect of this change on the EMS system in the area.

According to White Paper on Fire Service in 2018, the number of ambulance dispatch was 1.37 times higher, and the average time required to take a patient to a hospital was 1.34 times longer compared with 2003.[19] Due to the ageing population, this trend is most likely to continue. Systemic solutions to decrease ambulance diversion and shorten prehospital transfer time are needed.

This study has some limitations. First, this is a retrospective observational study that showed the association between decreased difficulty in hospital acceptance/shorter prehospital transfer time and the presence of MSPHs/EC3s. Therefore, we cannot conclude any causal relationship. We used surrogate markers as the endpoints, and we cannot determine if the presence of MSPHs and EC3s is associated with improved clinical outcomes. Due to a lack of previous data, we are unable to appropriately evaluate the significance of the effect size we observed in this study. We have tried to include factors that might affect difficulty in hospital acceptance and prehospital transport time, such as the number of hospital beds per capita, population density and time from dispatch to arrival at the scene; there might be unmeasured factors that were not included in the analysis. Bed number per capita counted in the analysis includes some beds that are not suitable for acute admission, which may limit the effects of adjustment in the multivariable regression analysis. Even though we used the nationwide database, it does not include transfers in Tokyo, the largest metropolitan area in Japan, because Tokyo uses a different EMS data recording system. As we do not have data on EMS transfer in Tokyo, where there is a rule to prevent ambulance diversion, we could not compare the outcome of prehospital transfer date between cities with and without rules to prevent ambulance diversion. Lastly, the study used Japanese data and may not have external validity as different countries have different systems. Nevertheless, we think facilities that are capable of providing both medical/surgical and psychiatric care are warranted in any country and could contribute to decreasing ambulance diversion for patients who need both medical/surgical and psychiatric care.

Conclusion

In conclusion, this retrospective observational study using nationwide ambulance transfer data showed that the presence of hospitals with both medical/surgical and psychiatric services and high-level emergency care centres was associated with decreased difficulty in hospital acceptance and shorter prehospital transfer time. Further research is warranted for appropriate medical policy-making to reduce ambulance diversion and improve the patient outcome for patients who need both physical and mental treatment.

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Contributors TC, TS, RT and HT were responsible for developing the initial research question and design. TC and TS were project administrators. TC prepared the original draft. RT and EI performed data curation and formal analysis. HT, MR, SI and TS reviewed and critically revised the manuscript for important intellectual content and approved the final version for publication. SI and TS supervised the project. TC is responsible for the overall content as guarantor.

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Patient consent for publication Not applicable.

Ethics approval This study involves human participants and was approved by the ethics committee at the International University of Health and Welfare (Institutional Review Board Approval Number 13-B-375). The informed consent was waived because the study data did not contain identifiable protected health information.

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Data availability statement Data may be obtained from a third party and are not publicly available. The data that support the findings of this study are available Ministry of Internal Affairs and Communications. Restrictions apply to the availability of these data, which were used under license for this study. Data are available from the authors with the permission of Ministry of Internal Affairs and Communications.

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Supplemental Table 1.

	All	Night-time	Day-time	Weekend/Holiday	Weekday
MSPHs	0.50***	0.51***	0.48***	0.57**	0.47***
	(0.38 - 0.66)	(0.37 - 0.70)	(0.28 - 0.83)	(0.34 - 0.94)	(0.34 - 0.65)
EC3s	0.63***	0.63***	0.61***	0.77**	0.57***
	(0.55 - 0.71)	(0.55 - 0.73)	(0.49 - 0.77)	(0.62 - 0.95)	(0.49 - 0.66)
Interaction terms (MSPH and EC3)	1.47**	1.40*	1.62	1.23	1.59**
	(1.07 - 2.01)	(0.97 - 2.03)	(0.87 - 3.01)	(0.69 - 2.20)	(1.09 - 2.33)
Psychiatry only hospitals	0.96	0.95	0.99	1.02	0.93
	(0.85 - 1.08)	(0.82 - 1.09)	(0.80 - 1.23)	(0.82 - 1.28)	(0.81 - 1.07)
Time from dispatch to arrival at the scene	1.02***	1.02**	1.02**	1.01	1.02***
	(1.01 - 1.02)	(1.00 - 1.03)	(1.00 - 1.03)	(0.99 - 1.03)	(1.01 - 1.03)
Emergency care center	1.02***	1.01***	1.02***	1.01***	1.02***
	(1.01 - 1.02)	(1.01 - 1.02)	(1.01 - 1.02)	(1.01 - 1.02)	(1.01 - 1.02)
Age	1.00***	1.00***	01.00**	0.99***	1.00**
	(0.99 - 1.00)	(0.99 - 1.00)	(0.99 - 1.00)	(0.99 - 1.00)	(0.99 - 1.00)
Female sex	1.11**	1.14**	1.07	1.18**	1.09
	(1.02 - 1.22)	(1.02 - 1.26)	(0.91 - 1.27)	(1.01 - 1.38)	(0.98 - 1.21)
Elderly rate	1.02***	1.02***	1.01	1.02	1.02***
	(1.01 - 1.03)	(1.01 - 1.04)	(0.99 - 1.03)	(1.00 - 1.04)	(1.01 - 1.03)
Population density	1.08***	1.10***	1.02	1.09***	1.07***
	(1.06 - 1.10)	(1.08 - 1.12)	(0.99 - 1.05)	(1.05 - 1.12)	(1.05 - 1.09)
Night time	1.45***			1.34***	1.50***
	(1.32 - 1.58)			(1.14 - 1.57)	(1.34 - 1.67)
Weekend/Holiday	1.13***	1.10*	1.22**		
	(1.04 - 1.23)	(0.99 - 1.22)	(1.04 - 1.43)		
Severity (baseline = mild)					
Moderate	1.12***	1.20***	0.94	1.09	1.13**
	(1.03 - 1.22)	(1.08 - 1.32)	(0.80 - 1.11)	(0.934 - 1.272)	(1.02 - 1.26)
Severe	0.46***	0.48***	0.40***	0.53***	0.42***
	(0.39 - 0.54)	(0.39 - 0.58)	(0.30- - 0.53)	(0.40 - 0.70)	(0.35 - 0.52)
Death	0.37***	0.43***	0.26***	0.47***	0.33***
	(0.31 - 0.45)	(0.34 - 0.54)	(0.19 - 0.38)	(0.34 - 0.65)	(0.26 - 0.42)
Place (baseline = home)					
Public place	0.83**	0.88	0.67**	0.83	0.82**
	(0.71 - 0.96)	(0.74 - 1.06)	(0.49 - 0.92)	(0.62 - 1.10)	(0.68 - 0.99)
Work place	0.93	1.01	0.8	0.66	1.04
	(0.58 - 1.51)	(0.55 - 1.86)	(0.36 - 1.76)	(0.24 - 1.78)	(0.60 - 1.81)
Road	0.94	0.92	1.02	1.01	0.92
	(0.77 - 1.16)	(0.72 - 1.16)	(0.67 - 1.55)	(0.71 - 1.43)	(0.71 - 1.18)
Other	0.86	0.95	0.66**	0.88	0.86
	(0.72 - 1.04)	(0.76 - 1.17)	(0.46 - 0.97)	(0.64 - 1.21)	(0.68 - 1.07)
Hospital beds per capita	1.00***	1.00**	1.00***	1.00*	1.00***
	(1.00 - 1.00)	(1.00 - 1.00)	(1.00 - 1.00)	(1.00 - 1.00)	(1.00 - 1.00)
Observations	32,849	21,181	11,668	9,692	23,157

95% CI in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Supplemental Table 2

	All	Night-time	Day-time	Weekend/Holiday	Weekday
MSPHs	-3.46***	-2.76***	-4.63***	-3.20***	-3.54***
	(-4.77 - -2.15)	(-4.54 - -0.97)	(-6.39 - -2.88)	(-5.58 - -0.82)	(-5.12 - -1.97)
EC3s	-4.21***	-4.38***	-3.931***	-3.83***	-4.37***
	(-4.89 - -3.53)	(-5.25 - -3.50)	(-5.01 - -2.86)	(-5.10 - -2.56)	(-5.18 - -3.57)
Interaction terms (MSPH and EC3)	3.11***	2.18**	4.74***	3.69***	2.86***
	(1.66 - 4.57)	(0.22 - 4.13)	(2.68 - 6.81)	(0.98 - 6.40)	(1.12 - 4.59)
Psychiatry only hospitals	0.21	0.41	-0.12	-0.38	0.46
	(-0.53 - 0.94)	(-0.52 - 1.35)	(-1.32 - 1.08)	(-1.78 - 1.03)	(-0.40 - 1.32)
Time from dispatch to arrival at the scene	0.73***	0.78***	0.66***	0.74***	0.73***
	(0.65 - 0.82)	(0.67 - 0.89)	(0.54 - 0.78)	(0.57 - 0.90)	(0.64 - 0.83)
Emergency care center	0.06***	0.06***	0.05**	0.06**	0.06***
	(0.04 - 0.08)	(0.04 - 0.09)	(0.01 - 0.08)	(0.01 - 0.10)	(0.03 - 0.09)
Age	-0.02***	-0.02*	-0.03***	-0.02	-0.02***
	(-0.03 - -0.01)	(-0.03 - 0.00)	(-0.05 - -0.01)	(-0.04 - 0.01)	(-0.04 - -0.01)
Female sex	0.20	0.03	0.47	0.66	0.01
	(-0.31 - 0.71)	(-0.63 - 0.69)	(-0.32 - 1.26)	(-0.27 - 1.58)	(-0.60 - 0.62)
Elderly rate	0.24***	0.26***	0.21***	0.24***	0.25***
	(0.17 - 0.32)	(0.17 - 0.36)	(0.09 - 0.32)	(0.10 - 0.37)	(0.16 - 0.33)
Population density	0.53***	0.67***	0.26***	0.60***	0.50***
	(0.42 - 0.64)	(0.52 - 0.81)	(0.09 - 0.44)	(0.37 - 0.82)	(0.37 - 0.63)
Night time	1.78***			1.15**	2.05***
	(1.230 - 2.27)			(0.23 - 2.07)	(1.48 - 2.62)
Weekend/Holiday	0.22	-0.12	0.78*		
	(-0.3 - 0.74)	(-0.77 - 0.53)	(-0.05 - 1.65)		
Severity (baseline = mild)					
Moderate	1.87***	1.97***	1.68***	2.69***	1.52***
	(1.29 - 2.46)	(1.25 - 2.69)	(0.67 - 2.69)	(1.59 - 3.79)	(0.82 - 2.21)
Severe	-6.60***	-5.93***	-7.58***	-5.83***	-6.94***
	(-7.32 - -5.88)	(-6.89 - -4.96)	(-8.65 - -6.50)	(-7.15 - -4.51)	(-7.80 - -6.08)
Death	-13.24***	-13.92***	-12.43***	-13.03***	-13.35***
	(-13.85 - -12.63)	(-14.70 - -13.14)	(-13.41 - -11.44)	(-14.16 - -11.90)	(-14.07 - -12.63)
Place (baseline = home)					
Public place	-0.97**	-0.91*	-1.08	-1.03	-0.95*
	(-1.82 - -0.11)	(-1.98 - 0.15)	(-2.53 - 0.38)	(-2.66 - 0.60)	(-1.96 - 0.07)
Work place	-2.66***	-2.56**	-2.66**	-0.92	-3.34***
	(-4.33 - -0.99)	(-5.05 - -0.07)	(-4.86 - -0.47)	(-4.12 - 2.28)	(-5.29 - -1.40)
Road	-0.47	-0.09	-1.36	-1.67	0.06
	(-1.83 - 0.89)	(-1.78 - 1.61)	(-3.58 - 0.87)	(-3.99 - 0.64)	(-1.61 - 1.73)
Other	1.94***	1.62**	2.46***	2.37**	1.74**
	(0.823 - 3.04)	(0.22 - 3.02)	(0.65 - 4.28)	(0.39 - 4.36)	(0.40 - 3.07)
Hospital beds per capita	-0.03***	-0.03***	-0.03***	-0.03***	-0.03***
	(-0.04 - -0.03)	(-0.03 - -0.02)	(-0.04 - -0.03)	(-0.04 - -0.02)	(-0.04 - -0.03)
Observations	32,849	21,181	11,668	9,692	23,157

95% CI in parentheses, *** p<0.01, ** p<0.05, * p<0.1