# Impact of closure of the in-house psychiatric care unit on prehospital and emergency ward length of stay and disposition locations in patients who attempted suicide: A retrospectiv…

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# Impact of closure of the in-house psychiatric care unit on prehospital and emergency ward length of stay and disposition locations in patients who attempted suicide

## A retrospective before-and-after cohort study at a community hospital in Japan

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## Abstract

Suicide is an increasingly serious public health care concern worldwide. The impact of decreased in-house psychiatric resources on emergency care for suicidal patients has not been thoroughly examined. We evaluated the effects of closing an in-hospital psychiatric ward on the prehospital and emergency ward length of stay (LOS) and disposition location in patients who attempted suicide.

This was a retrospective before-and-after study at a community emergency department (ED) in Japan. On March 31, 2014, the hospital closed its 50 psychiatric ward beds and outpatient consultation days were decreased from 5 to 2 days per week. Electronic health record data of suicidal patients who were brought to the ED were collected for 5 years before the decrease in in-hospital psychiatric services (April 1, 2009–March 31, 2014) and 5 years after the decrease (April 1, 2014–March 31, 2019). One-to-one propensity score matching was performed to compare prehospital and emergency ward LOS, and discharge location between the 2 groups.

Of the 1083 eligible patients, 449 (41.5%) were brought to the ED after the closure of the psychiatric ward. Patients with older age, burns, and higher comorbidity index values, and those requiring endotracheal intubation, surgery, and emergency ward admission, were more likely to receive ED care after the psychiatric ward closure. In the propensity matched analysis with 418 pairs, the after-closure group showed a significant increase in median prehospital LOS (44.0 minutes vs 51.0 minutes, $P < .001$) and emergency ward LOS (3.0 days vs 4.0 days, $P = .014$) compared with the before-closure group. The rate of direct home return was significantly lower in the after-closure group compared with the before-closure group (87.1% vs 81.6%, odds ratio: 0.66; 95% confidence interval: 0.45–0.96).

The prehospital and emergency ward LOS for patients who attempted suicide in the study site increased significantly after a decrease in hospital-based mental health services. Conversely, there was significant reduction in direct home discharge after the decrease in in-house psychiatric care. These results have important implications for future policy to address the increasing care needs of patients who attempt suicide.

## 1. Introduction

Suicide is the leading cause of death and disability among young people and involves a substantial economic burden for society.[1] The World Health Organization reported that over 800,000 people die from suicide annually, with as many as 16 million people attempting suicide each year.[2] In Japan, >20,000 people died by suicide in 2019, and suicide was the most common cause of death among men aged 10 to 44 years and women aged 15 to 34 years.[3] In the COVID-19 pandemic, concerns have been raised that rates of suicide will increase further, or have already increased.[4–6] Thus, suicide is a growing public health issue worldwide, and is a particularly major problem in the Japanese context.

Patients who have attempted suicide are a distinct demographic in the emergency department (ED). Because many suicide attempts and self-harm episodes result in ED visits, the ED often functions as the primary or sole point of contact with the healthcare system,[7] and serves as a safety net. In-house psychiatric resources such as suicide risk assessment provided by psychiatric consultants, close monitoring and care provided by psychiatric nurses, and in-house psychiatric wards that admit patients requiring emergency psychiatric care provide important back-up support for this particularly vulnerable patient population in ED. However, there is currently a lack of literature documenting and quantifying the effects of hospital-based psychiatric care resources on specific outcomes of suicidal patients. Several studies identified a slight increase in ED length of stay (LOS) among patients with mental illness after closure of nearby psychiatric hospital(s).[8–10] However, these studies did not focus on suicidal patients, and did not shed light on the effects of in-hospital psychiatric resources.[8–10] In addition, past studies have not measured the prehospital and emergency ward LOS, and have not clarified the difference in discharge locations after the decline in hospital-based mental health services,[8–10] despite these parameters being important clinical outcomes, particularly in patients with time-sensitive self-harm injuries brought to the ED.

Despite an increasing number of ED presentations with patients with mental health complaints,[11–14] psychiatric services are frequently targeted by funding cuts. "Deinstitutionalization" has become a common concept in psychiatric care, describing the process of closure or downsizing of psychiatric hospitals or psychiatric beds and the establishment of alternative services in the community.[15] For example, >20,000 psychiatric beds have been closed in Japan in the past 15 years.[16] Our hospital, which serves a tertiary emergency medical center in the community, has also closed 50 psychiatric beds in accord with this trend on March 31, 2014. All of the full-time psychiatrists and psychiatric nurses on staff were fired or transferred at that time. This natural-experiment setting allows us to investigate whether the availability of a hospital-based psychiatric care system at a tertiary community hospital had a direct effect on the specific outcomes of suicidal patients.

Using a before-and-after natural-experiment design, we sought to compare prehospital and hospital LOS, disposition locations, and ED admission capacity for suicidal patients who were brought to the ED before and after closure of the psychiatric care unit. We hypothesized that these patients would exhibit increased LOS both in the prehospital setting and emergency ward after the decrease in in-hospital psychiatric resources. We further hypothesized that a decrease in both direct discharge to home and ED admission capacity would occur after the closure of the psychiatric ward.

## 2. Materials and methods

### 2.1. Study design and setting

The current study was a retrospective, before-and-after cohort study at a community hospital located in a provincial Japanese city. The review board at Ohta Nishinouchi Hospital approved this study on June 8, 2020 (Approval No. 2006). The committee waived the need for patient consent. The hospital serves as a teaching and tertiary care facility for a population of 538,000 inhabitants within a 50-km radius. The hospital is the only tertiary and referral medical center in this medical area. Annually, the ED receives >5500 ambulances carrying patients with conditions of varying severity, and approximately 2% of these are patients who attempted suicide or engaged in self-harm. Before 2014, the hospital had 1006 general ward beds, 30 emergency ward beds, and 50 psychiatric beds. In line with the current trend of "deinstitutionalization,"[15] the psychiatric unit was closed on March 31, 2014 and all full-time psychiatrists and psychiatric nurses on staff were fired or transferred to other departments. The annual number of psychiatrists, psychiatric nurses, and psychiatric social workers during the study period is shown in Figure S1, Supplemental Digital Content, http://links.lww.com/MD/G168.

At the study site, all suicidal patients who appeared in the ED were initially evaluated by an emergency medical team consisting of attending emergency physicians, emergency medicine residents, post-graduate year 1 or 2 junior residents, and nurses. Before closure of the psychiatric unit, a psychiatric consultation was provided by in-house psychiatrists, and was available 8 hours a day and 5 days a week. After closure of the psychiatric unit, psychiatric consultations were less available: a part-time psychiatrist now provides consultation 8 hours a day on 2 days each week. There are 3 psychiatric hospitals and 1 general hospital with a psychiatric department within a 50-km radius of the study site. The mental health service offerings of these hospitals and psychiatric emergency medical institutions remained relatively unchanged throughout the study period.

### 2.2. Participants and data sources

The current study included all suicidal patients brought to the ED from April 1, 2009 to March 31, 2019. The exclusion criteria

were patients who received ongoing cardiopulmonary resuscitation on initial contact and patients who were transported from other facilities. The data were collected from a hospital-based electronic database, which prospectively captures each patient's age, sex, comorbidities, ED presentation date and time, requirement of emergency endotracheal intubation (ETI) and emergency surgery, method of suicide attempt (hanging, trauma, poisoning or drug overdose, and burning), prehospital LOS (time from emergency call to ED arrival), emergency ward LOS (time from emergency ward admission to hospital discharge or transfer), and discharge location (discharge to home, transferred to psychiatric hospitals, and transferred to non-psychiatric hospitals or nursing home). These parameters were entered into the database at the earliest possible opportunity by one of the authors (KS). To mitigate therapeutic bias, the participating emergency physicians and psychiatrists who provided emergency care for suicidal patients were blinded to the existence of the study throughout the study period. To reduce the risk of biased assessment, the investigator who constructed the database (KS) did not participate in any of the statistical analyses.

### 2.3. Exposures and outcome measurement

The primary exposure was the closure of the psychiatric unit on March 31, 2014. Electronic health record data of suicidal patients who were brought to the ED were collected for 5 years before the decrease in in-hospital psychiatric services (April 1, 2009–March 31, 2014) and 5 years after the decrease (April 1, 2014–March 31, 2019). The primary outcome measures were emergency ward and prehospital LOS. The other outcomes of interest in this study were discharge location and the number and percentage of suicidal patients presenting to the ED.

### 2.4. Statistical analysis

All analyses were performed according to an a priori statistical analysis plan. Initially, both a crude and a matching analysis were performed between patients who were admitted before and after closure of the psychiatric unit. A matching analysis was designed based on estimated propensity scores (PS) of each patient. To estimate the PS, a logistic regression model was fitted for ED admission after the psychiatric unit closure as a function of patient demographics, including age, sex, Charlson Comorbidity index (0, 1, 2, and ≥3), diagnosed mental illness, presentation time (8:00–16:59, 17:00–23:59, and 24:00–7:59), presentation day (weekend, Saturday–Sunday and weekdays, Monday–Friday), seasons (spring, March–May; summer, June–August; autumn, September–November; and winter, December–February) coma with Glasgow coma scale (GCS) score <9, hypotension with systolic blood pressure (SBP) <80 mm Hg, requirement of emergency ETI and emergency surgery, and method of suicide attempt (hanging, trauma, intoxication, and burn). All categorical variables mentioned above were dummy coded and incorporated into the PS model. The $c$ statistic for evaluating the goodness of fit was calculated. The standardized difference (SD) was used to evaluate the covariate balance, and an absolute SD of >10% represents meaningful imbalance.[17] Each suicidal patient admitted to our ED before the psychiatric unit closure was matched with those who were admitted to the ED after closure with the nearest estimated propensity on the logit scale within a specified range (0.2 of the pooled standard deviation of estimated logits) to reduce the characteristic differences between 2 groups.

If ≥2 patients in the after-closure group met this criterion, 1 patient was randomly selected for matching. The Mann–Whitney $U$ test was used to compare the emergency ward and prehospital LOS before and after closure of the psychiatric unit. Chi-squared tests were used to compare patients' dispositions including discharge to home, transfer to psychiatric hospitals, and non-psychiatric hospitals or nursing homes between the 2 groups. To evaluate the robustness of the PS-matching analysis, prehospital and emergency ward LOS were also compared by drawing the cumulative event rate curve and log rank tests. All statistical analyses were performed using SPSS Statistics for Windows, version 25.0 (IBM Corp., Armonk, NY). A $P$ value of <.05 was considered to indicate statistical significance. The cumulative event rate curves were generated using GraphPad Prism 8 (GraphPad Software, San Diego, CA).

### 2.5. Power analysis

To the best of our knowledge, no previous study has measured emergency ward and prehospital LOS of suicidal patients before and after the closure of a psychiatric unit. The scarcity of relevant data prevented accurate estimation of statistical power in advance. Rather, we used all collectable data during the study period, and the observed power was computed post hoc using G*Power 3 for Windows (Heinrich Heine University, Dusseldorf, Germany).

### 3. Results

During the study period, 54,403 patients were brought to the ED (Fig. 1). Of these, 1216 (2.2%) were suicidal patients and enrolled in this study. Among them, 68 patients who received ongoing cardiopulmonary resuscitation and 65 patients who were transported from other facilities were excluded. The remaining 1083 patients were included in the crude analysis. Using one-to-one PS matching, 418 pairs of patients who were admitted before and after the closure of the psychiatric unit were selected. Complete records were available for all patients, and no data were missing from the analyses. The $c$-statistic for goodness of fit was 0.67 in the PS model. Figure S2, Supplemental Digital Content, http://links.lww.com/MD/G169 shows the distributions of PS in the unmatched and matched groups.

Table 1 shows the patient demographics of all patients (n = 1083) and the PS-matched patients (n = 836). Among all patients, the average age in the before closure group (40.1 ± 18.5 years) was less than that of the after-closure group (43.4 ± 19.5 years). Before closure of the psychiatric unit, the hospital was more likely to receive patients with diagnosed mental illness (before 67.8% vs after 59.2%), patients who presented between 8:00 and 16:59 (40.5% vs 34.1%), and patients who attempted suicide by poisoning or drug overdose (73.0% vs 65.9%) compared with after closure of the psychiatric unit. Meanwhile, the proportion of male patients (before 35.3% vs after 42.3%), patients with Charlson Comorbidity Index values ≥3 (0.9% vs 4.5%), patients who presented between 17:00 and 23:59 (33.0% vs 41.0%), patients who required emergency ETI (16.2% vs 20.9%), emergency surgery (6.6% vs 10.7%), and emergency ward admission (78.2% vs 85.5%), and patients who attempted suicide by burning (3.2% vs 5.6%) were significantly higher in the after-closure group compared with the before-closure group. After PS-matching, patient distributions were closely balanced with all SD <10% between 2 groups.
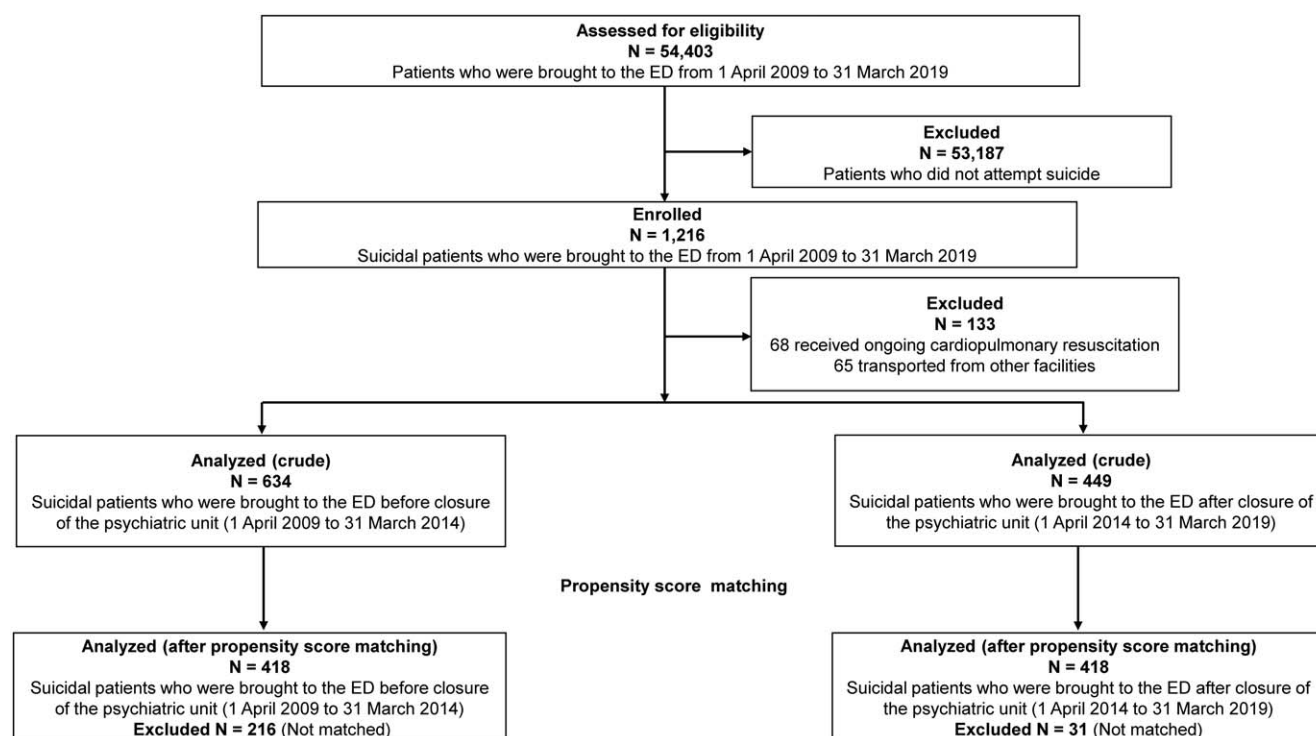
**Figure 1.** Flow chart showing the selection process for suicidal patients included in the analyses. ED = emergency department.

Figure 2 shows the prehospital and emergency ward LOS before and after closure of the psychiatric ward. The median duration of prehospital stay was significantly longer in the after-closure group compared with the before-closure group both in crude (42.0 minutes vs 52.0 minutes, $P < .001$) and PS matching analyses (44.0 minutes vs 51.0 minutes, $P < .001$). Similarly, the median emergency ward LOS was significantly longer in the after-closure group compared with the before-closure group both in crude (3.0 days vs 4.0 days, $P < .001$) and PS matching analysis (3.0 days vs 4.0 days, $P = .014$). A similar trend remained in the cumulative event rate curve analysis and log rank tests (Figure S3, Supplemental Digital Content, http://links.lww.com/MD/G170).

Figure 3 shows differences in patient disposition before and after closure of the in-house psychiatric care unit. The rate of direct discharge to home was significantly lower in the after-closure group compared with the before-closure group in both crude (before 88.0% vs after 81.7%, odds ratio [OR]: 0.61, 95% confidence interval [CI]: 0.43–0.86) and PS-matched analyses (87.1% vs 81.6%, OR 0.66, 95% CI 0.45–0.96). Conversely, the proportion of patients transferred to psychiatric hospitals was significantly increased after closure of the psychiatric unit in both crude (before 3.6% vs after 13.4%, OR 4.10, 95% CI 2.49–6.74) and PS-matched analyses (3.3% vs 13.4%, OR 4.46, 95% CI 2.44–8.16). There were no significant differences between the 2 groups in the proportion of patients transferred to non-psychiatric hospitals or nursing homes in both the crude (1.9% vs 1.3%, OR 0.70, 95% CI 0.26–1.89) and PS-matched analyses (2.6% vs 1.4%, OR 0.54, 95% CI 0.20–1.47).

Figure S4, Supplemental Digital Content, http://links.lww.com/MD/G171 shows the number and percentage of suicidal patients who were brought to the ED before and after closure of the psychiatric unit. The ED capacity of admitting suicidal patients started to decline 3 years before closure of the psychiatric unit and did not recover over several years.

## 4. Discussion

This single-site observational study compared clinical outcomes before and after the reduction in in-hospital psychiatric resources. The current results revealed substantial differences in patients' characteristics between before and after closure of the psychiatric care unit. We therefore conducted a PS-matched analysis to adjust for patients' demographic and clinical characteristics based on measured variables. Both crude and adjusted analysis showed that the decrease in in-house mental health services was associated with an increased prehospital and emergency ward LOS in patients who attempted suicide. On the contrary, there was a significant reduction in direct home return and ED admission capacity of suicidal patients after closure of the psychiatric care unit. Our results indicated that hospital-based psychiatric services had a direct effect on emergency care in patients who attempted suicide or engaged in self-harm.

Using real-world data, we first attempted to describe how closure of the in-hospital psychiatric ward affected emergency care for suicidal patients. After the psychiatric ward closure, the ED was more likely to receive patients with older age, higher comorbidity index, and burns, as well as patients who required ETI, surgery, and emergency ward admission. These results suggest that the ED tended to focus on suicidal patients in a more physically severe condition as in-hospital psychiatric care resources became less available. This pre-post study also found that the ED admission capacity for suicidal patients started to decrease 3 years before closure of the psychiatric unit and did not recover for several years. The ED often functions as the entry

**Table 1**

Demographic and clinical characteristics of suicidal patients before and after closure of the psychiatric ward.

| | Unmatched groups | | | | PS matched groups | | | |
|---|---|---|---|---|---|---|---|---|
| | Before closure (n=634) | After closure (n=449) | P | SD (%) | Before closure (n=418) | After closure (n=418) | P | SD (%) |
| Age | 40.1±18.5 | 43.4±19.5 | .004 | 17.4 | 41.9±18.6 | 42.5±19.5 | .636 | 3.1 |
| Male | 224 (35.3) | 190 (42.3) | .020 | 14.4 | 173 (41.4) | 174 (41.6) | .944 | 0.4 |
| Charlson Comorbidity index | | | .020 | | | | .593 | |
| 0 | 535 (84.4)** | 355 (79.1)* | | −14.0 | 335 (80.1) | 346 (82.8) | | 8.9 |
| 1 | 66 (10.4) | 44 (9.8) | | −2.0 | 50 (12.0) | 39 (9.3) | | 7.0 |
| 2 | 27 (4.3) | 30 (6.7) | | 10.5 | 27 (6.5) | 25 (6.0) | | −8.8 |
| ≥3 | 6 (0.9)* | 20 (4.5)** | | 22.3 | 6 (1.4) | 8 (1.9) | | −2.1 |
| Diagnosed mental illness | 430 (67.8) | 266 (59.2) | .004 | −17.9 | 261 (62.4) | 258 (61.7) | .831 | −1.4 |
| Season | | | .315 | | | | .974 | |
| Spring (March–May) | 152 (24.0) | 130 (29.0) | | 11.3 | 113 (27.0) | 117 (28.0) | | 2.2 |
| Summer (June–August) | 202 (31.9) | 137 (30.5) | | −2.9 | 124 (29.7) | 125 (29.9) | | 0.4 |
| Autumn (September–November) | 147 (23.2) | 98 (21.8) | | −3.3 | 94 (22.5) | 94 (22.5) | | 0 |
| Winter (December–February) | 133 (21.0) | 84 (18.7) | | −5.7 | 87 (20.8) | 82 (19.6) | | −3.0 |
| Presentation time | | | .020 | | | | .323 | |
| 8:00–16:59 | 257 (40.5)** | 153 (34.1)* | | −13.4 | 162 (38.8) | 145 (34.7) | | −8.5 |
| 17:00–23:59 | 209 (33.0)* | 184 (41.0)** | | 16.7 | 147 (35.2) | 167 (40.0) | | 9.8 |
| 24:00–7:59 | 168 (26.5) | 112 (24.9) | | −3.6 | 109 (26.1) | 106 (25.4) | | −1.6 |
| Presentation day | | | | | | | | |
| Weekends | 160 (25.2) | 137 (30.5) | .055 | 11.8 | 127 (30.4) | 123 (29.4) | .763 | −2.2 |
| Physiological severity | | | | | | | | |
| GCS score < 9 | 133 (21.0) | 84 (18.7) | .358 | −5.7 | 84 (20.1) | 82 (19.6) | .862 | −1.3 |
| SBP < 80 mm Hg | 41 (6.5) | 22 (4.9) | .278 | −6.8 | 23 (5.5) | 22 (5.3) | .878 | −0.9 |
| Intervention | | | | | | | | |
| Emergency ETI | 103 (16.2) | 94 (20.9) | .049 | 12.1 | 81 (19.4) | 83 (19.9) | .862 | 1.3 |
| Emergency surgery | 42 (6.6) | 48 (10.7) | .017 | 14.5 | 39 (9.3) | 40 (9.6) | .906 | −0.9 |
| Method of suicidal attempt | | | .040 | | | | .774 | |
| Hanging | 22 (3.5) | 15 (3.3) | | −0.7 | 12 (2.9) | 15 (3.6) | | 3.9 |
| Trauma | 129 (20.3) | 113 (25.2) | | 11.5 | 98 (23.4) | 103 (24.6) | | 2.8 |
| Poisoning or drug overdose | 463 (73.0)** | 296 (65.9)* | | −15.5 | 290 (69.4) | 278 (66.5) | | −6.2 |
| Burn | 20 (3.2)* | 25 (5.6)** | | 11.8 | 18 (4.3) | 22 (5.3) | | 4.7 |
| Emergency ward admission | 496 (78.2) | 384 (85.5) | .002 | 19.0 | 342 (81.8) | 355 (84.9) | .227 | 8.3 |

Data are expressed as mean±standard deviation or n (%).

ETI = endotracheal intubation, GCS = Glasgow coma scale, PS = propensity scores, SBP = systolic blood pressure, SD = standardized difference.

* Adjusted standardized residual < −1.96.

** Adjusted standardized residual > 1.96.

point to the healthcare system for patients who have attempted suicide.[7] The current results suggest that this important function of the ED was significantly affected by a reduction in in-hospital psychiatric resources. The information presented herein should be considered by hospital administrators and policymakers, as well as by emergency and psychiatric health care providers.

The current study showed that prehospital LOS was significantly increased after the reduction in in-house psychiatric resources, and this finding persisted in both crude and PS-matched analysis. These associations also remained significant for other statistical analyses using cumulative event rate curve analysis and log rank tests. There are several possible reasons for these observed findings. With increased rates of hospitalization, increased ED LOS, more frequent return visits, and safety concerns, patients with intentional self-harm or drug overdose pose a challenge for EDs.[18–20] Without in-hospital psychiatric backup, emergency physicians and other healthcare professionals may hesitate to receive patients from this challenging population.[18,20] This hesitation in acceptance by emergency medical teams may, in turn, result in prolonged prehospital LOS. The presence of hesitation was supported by the finding that the number of suicidal patients brought to the ED was markedly

decreased after closure of the in-house psychiatric ward. A recent study from Japan also indicated that self-induced drug abuse/poisoning and self-induced trauma were positively associated with difficulty in hospital acceptance at the scene and resulted in prolonged prehospital LOS.[21] This phenomenon may have become even more evident after decreasing in-hospital psychiatric care resources. Our findings were also consistent with previous studies reporting that patients with mental illness had increased ED LOS after closure of nearby psychiatric hospital(s).[8–10] Prolonged prehospital and ED LOS is reported to be related to a high degree of provider stress, a greater risk of adverse events, and lower levels of patient satisfaction,[22] as well as a greater risk of poor outcomes.[23–27] These results, together with the current findings, collectively illustrate the importance of community or hospital-based psychiatric backup when seeing suicidal patients in an acute care hospital.

We also found that a decrease in in-house mental health services was associated with increased emergency ward LOS and psychiatric hospital transfer and reduced direct home return. These findings were consistent in both unmatched and PS-matched analysis. The association between increased emergency ward LOS and psychiatric ward closure remained with the use of
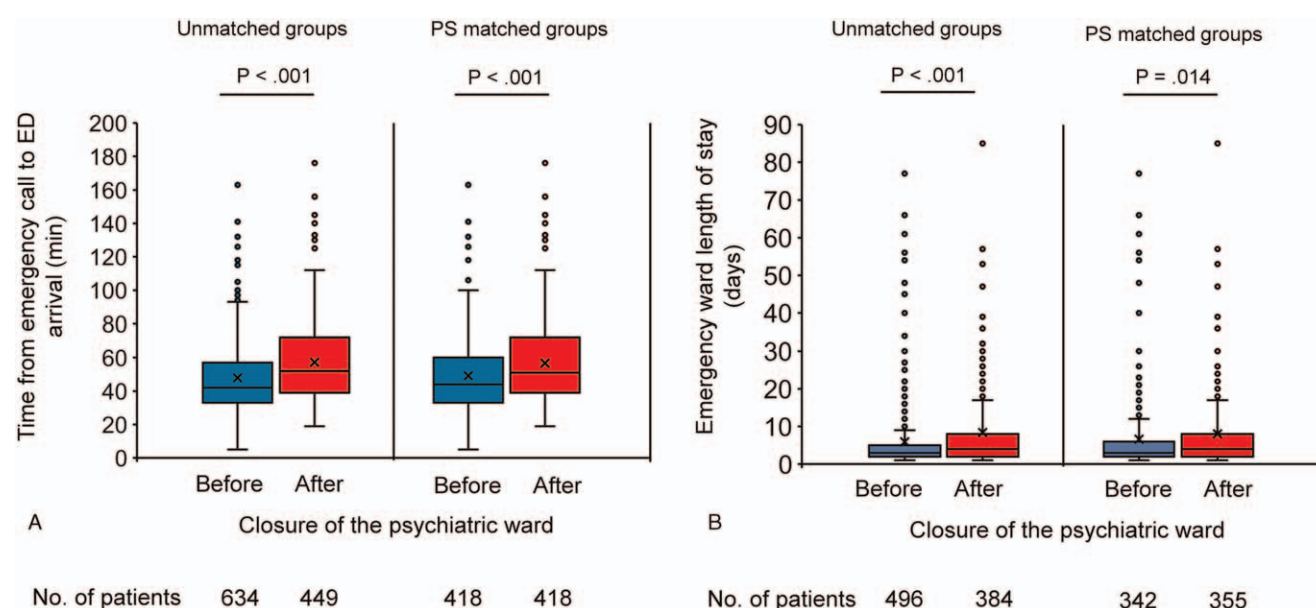
**Figure 2.** Prehospital time and emergency ward length of stay in suicidal patients: before versus after closure of the psychiatric ward. Box plots of time from emergency call to ED arrival (A) and emergency ward length of stay (B) in suicidal patients. The solid line inside the box represents the median, x represents the mean, the box represents the 25th and 75th percentiles, the whiskers represent the lower and upper extremes, and the circles represent outliers. The P value was derived from the Mann–Whitney U test. ED = emergency department, PS = propensity scores.

cumulative event rate curve analysis. There are several plausible explanations for these observed findings. Because a prior suicide attempt or self-harm episode has been shown to be the single most important risk factor for completed suicide,[28,29] determining the suicide risk and disposition location is a vital task with important consequences. However, most emergency physicians have limited training opportunities for risk assessment of suicidal patients.[20] Furthermore, several suicide screening scales have been advocated for use in the ED setting,[30,31] but were found to be inadequate for predicting suicide risk.[32–34] With a lack of education in the care of psychiatric patients and a lack of standard assessment tools, it would be difficult for emergency physicians to treat and assess patients who attempted suicide or engaged in self-harm. Therefore, most of these tasks involving a high level of responsibility are left to psychiatric consultants. If in-hospital psychiatric consultation becomes less available, it is likely to result in increased psychiatric hospital transfers and emergency ward LOS. Prolonging hospital LOS occupies beds and caregivers for a longer time, increases healthcare costs and economic burden,[35,36] and increases complications unrelated to admission diagnosis, such as hospital-acquired infections.[37,38] A shortage of psychiatric services is a ubiquitous problem in Japanese EDs,[7] despite the increasing number of ED presentations of patients with psychiatric illnesses. Taken together, these findings suggest a need for promoting access to psychiatric care systems in acute-care hospitals when treating suicidal patients.

### 4.1. Limitations and strengths

Several limitations of the current study should be acknowledged. First, this study was performed at a single site, limiting the generalizability of the findings. Second, although rigorous adjustments were made using a PS-matched analysis, other unmeasured factors may have confounded our results, as with any observational study. For example, our survey did not record information such as marital status (single, married, divorced, or widowed), insurance status, previous suicide attempts, or detailed diagnosis of mental illness (e.g., bipolar affective disorder, schizophrenia, substance use, personality disorder). Further analyses including such in-depth information will be required to further clarify the association between reduced in-hospital psychiatric resources and measured clinical outcomes. Third, the current study was unable to assess the relationship between the availability of in-hospital psychiatric resources and repeated suicide attempts, completed suicides, hospital-acquired complications, and healthcare cost. Our database also did not record information regarding changes in the difficulty of hospital acceptance (e.g., numbers of phone calls by emergency medical service personnel until a decision to transport) before and after closure of the psychiatric care unit. In addition, this study did not have sufficient statistical power to clarify how prolonging prehospital and emergency ward LOS after psychiatric ward closure can affect survival and functional outcomes of patients who attempted suicide. Further investigations examining these outcomes should be conducted in the future. Fourth, we did not calculate the sample size in advance. As described in the Methods section, we were unable to estimate the precise sample size because of the scarcity of previous data. However, a post hoc power calculation demonstrated that the power of our study was sufficient (power > 0.80) for all primary outcomes examined.

Despite these limitations, the current study also had several strengths. First, our study provided objective information regarding the association between the closure of the psychiatric care unit and increased prehospital and emergency ward LOS in suicidal patients. To the best of our knowledge, this study is the first to clarify this relationship in this important subset of patients. Our results demonstrate that the presence of an in-hospital psychiatric department can indeed affect the quality of acute care for suicidal patients. We hope that our current study brings attention to the need for increased psychiatric services
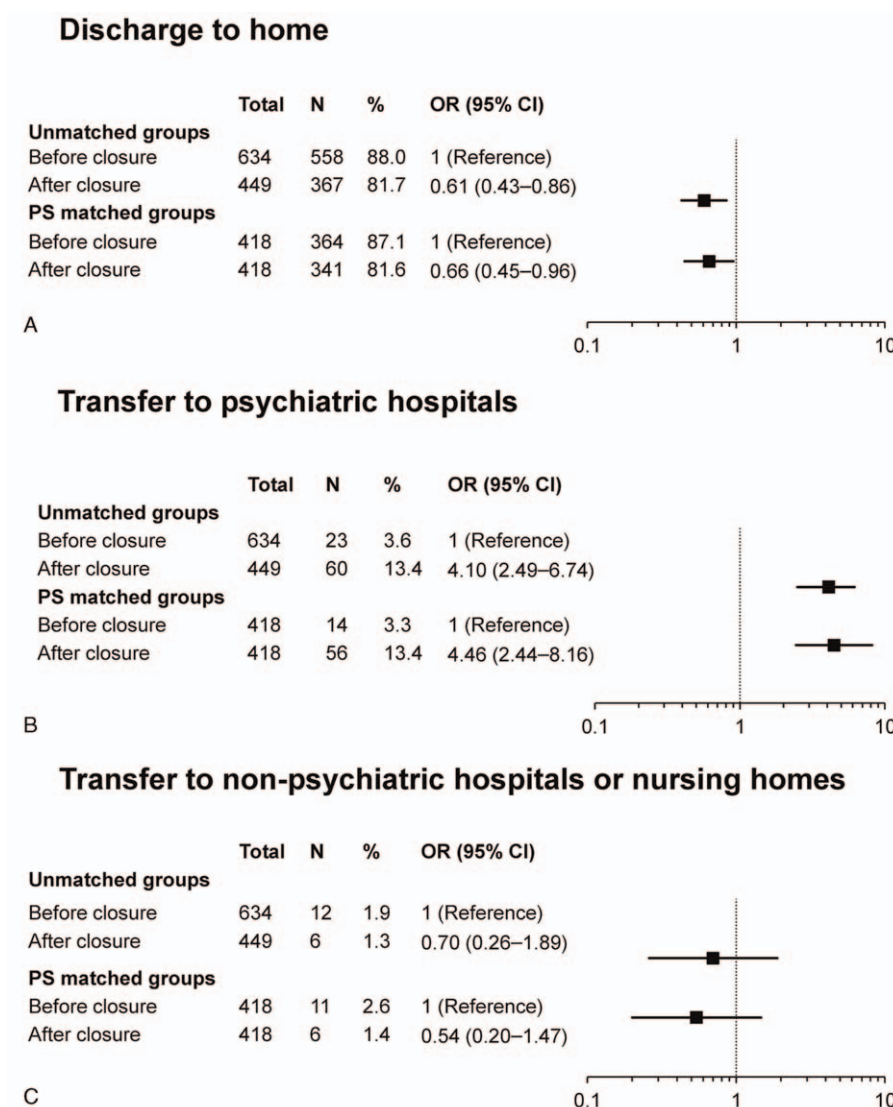
## Discharge to home

| | Total | N | % | OR (95% CI) |
|---|---|---|---|---|
| **Unmatched groups** | | | | |
| Before closure | 634 | 558 | 88.0 | 1 (Reference) |
| After closure | 449 | 367 | 81.7 | 0.61 (0.43–0.86) |
| **PS matched groups** | | | | |
| Before closure | 418 | 364 | 87.1 | 1 (Reference) |
| After closure | 418 | 341 | 81.6 | 0.66 (0.45–0.96) |

A

## Transfer to psychiatric hospitals

| | Total | N | % | OR (95% CI) |
|---|---|---|---|---|
| **Unmatched groups** | | | | |
| Before closure | 634 | 23 | 3.6 | 1 (Reference) |
| After closure | 449 | 60 | 13.4 | 4.10 (2.49–6.74) |
| **PS matched groups** | | | | |
| Before closure | 418 | 14 | 3.3 | 1 (Reference) |
| After closure | 418 | 56 | 13.4 | 4.46 (2.44–8.16) |

B

## Transfer to non-psychiatric hospitals or nursing homes

| | Total | N | % | OR (95% CI) |
|---|---|---|---|---|
| **Unmatched groups** | | | | |
| Before closure | 634 | 12 | 1.9 | 1 (Reference) |
| After closure | 449 | 6 | 1.3 | 0.70 (0.26–1.89) |
| **PS matched groups** | | | | |
| Before closure | 418 | 11 | 2.6 | 1 (Reference) |
| After closure | 418 | 6 | 1.4 | 0.54 (0.20–1.47) |

C

**Figure 3.** Differences in discharge locations: before versus after closure of the psychiatric ward. CI = confidence interval, OR = odds ratio, PS = propensity scores.

during a nationwide trend toward the reduction of available psychiatric inpatient beds. Second, the data for this study were gathered from existing electronic databases, meaning that no abstraction from patient records was performed. Thus, ascertainment bias was less likely. The measured outcomes were objective (i.e., prehospital and emergency ward LOS, location of patient dispositions), less prone to diagnostic errors, and all data were entered into the database by only one trained emergency physician (author KS). In addition, there were no missing data for all relevant analyses. To mitigate the risk of biased assessment, author KS, who constructed the database, was not involved in the any of the statistical analysis. We therefore believe that the current study accurately depicts the impact of closure of a psychiatric ward in a typical Japanese ED.

## 5. Conclusions

The prehospital and emergency ward LOS for patients who attempted suicide in the study site increased significantly after a decrease in hospital-based mental health services. Conversely, there was a significant reduction in direct home return and ED admission capacity of suicidal patients after the decrease in the in-house psychiatric care system. We believe that our results have important implications for future policy to address the increasing care needs of patients who attempted suicide or engaged in self-harm.

## Author contributions

**Conceptualization:** Yuko Ono, Nozomi Ono.

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**Formal analysis:** Yuko Ono, Takeyasu Kakamu.
**Investigation:** Yuko Ono, Kazuaki Shinohara.
**Methodology:** Yuko Ono, Takeyasu Kakamu.
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