Psychiatric intervention and repeated admission to emergency centres due to drug overdose
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Background
Repeated drug overdose is a major risk factor for suicide. Data are lacking on the effect of psychiatric intervention on preventing repeated drug overdose.

Aims
To investigate whether psychiatric intervention was associated with reduced readmission to emergency centres due to drug overdose.

Method
Using a Japanese national in-patient database, we identified patients who were first admitted to emergency centres for drug overdose in 2010–2012. We used propensity score matching for patient and hospital factors to compare readmission rates between intervention (patients undergoing psychosocial assessment) and unexposed groups.

Results
Of 29 564 eligible patients, 13 035 underwent psychiatric intervention. In the propensity-matched 7938 pairs, 1304 patients were readmitted because of drug overdose. Readmission rate was lower in the intervention than in the unexposed group (7.3% v. 9.1% respectively, P<0.001).

Conclusions
Psychiatric intervention was associated with reduced readmission in patients who had taken a drug overdose.

Data source
The Diagnosis Procedure Combination (DPC) database is a national in-patient database in Japan that includes administrative claims data and detailed patient data. As of 2012, the database included the data of approximately 7 million in-patients from more than 1000 hospitals in Japan, representing around 50% of all acute care in-patient admissions. The database consists of the following information: unique hospital identifiers; age and gender main diagnoses, comorbidities present on admission, and complications that occurred after admission recorded with text data in Japanese and using ICD-10 codes; procedures; and discharge status. The responsible physicians are obliged to record the diagnoses with reference to medical charts on discharge. For the main diagnosis, the physicians have to enter only one ICD code.

Participant selection and data
We identified patients with a diagnosis of drug poisoning (ICD-10 codes: T360–T509) who were discharged from participating hospitals between 1 July 2010 and 31 March 2013 (33 months in total). We included patients aged 12 years or older with a first episode of drug overdose and who visited a hospital with at least one full-time psychiatrist during the study period. We excluded patients who died during admission to hospital.

We identified psychiatric intervention by means of procedure codes for ‘interview for assessment and/or psychotherapy by a psychiatrist’, coded using the Japanese Procedure Codes defined under the fee schedule of the national health insurance system. We divided the patients into two groups: (a) those who received a psychiatric intervention – the psychiatric intervention group; and (b) those who did not – the unexposed group.

Based on the protocol of Quan et al, we converted ICD-10 codes of comorbidities that were present on admission into scores for each patient to calculate the Charlson comorbidity index (CCI). This index is used to predict mortality by classifying or weighting comorbidities to assess disease burden and case mix. Hospital volume was defined as the number of patients with the diagnosis of drug overdose annually at each hospital; it was
| Demographic and clinical characteristics of the psychiatric intervention and unexposed groups | All patients | Psychiatric intervention group | Absolute standardised difference | Propensity-matched patients | Psychiatric intervention group | Absolute standardised difference |
|---|---|---|---|---|---|---|
| | Unexposed group | n=16 529 | | | n=13 035 | | |
| | | n | % | n | % | n | % | n | % | n | % | n | % | n | % |
| Female | 10 944 | 66.2 | 9310 | 71.4 | 11.2 | 5520 | 70.8 | 5576 | 70.2 | 1.3 |
| Age, years | 12–19 | 10 44 | 6.3 | 884 | 6.8 | 2.0 | 550 | 6.9 | 523 | 6.6 | 1.2 |
| | 20–29 | 34 01 | 20.6 | 3181 | 24.4 | 9.1 | 1978 | 24.9 | 1877 | 23.6 | 3.0 |
| | 30–39 | 32 93 | 19.9 | 3315 | 25.4 | 13.2 | 1955 | 24.6 | 1934 | 24.4 | 0.5 |
| | 40–49 | 26 51 | 16.0 | 2564 | 19.7 | 9.7 | 1559 | 19.6 | 1558 | 19.6 | 0.0 |
| | 50–59 | 14 68 | 8.9 | 1343 | 10.3 | 4.8 | 786 | 9.9 | 791 | 10.0 | 0.3 |
| | 60–69 | 13 89 | 8.4 | 874 | 6.7 | 6.6 | 530 | 6.7 | 567 | 7.1 | 1.6 |
| | 70–79 | 14 41 | 8.7 | 548 | 4.2 | 18.4 | 358 | 4.6 | 400 | 5.1 | 1.9 |
| | 80–89 | 14 42 | 8.7 | 289 | 2.2 | 28.9 | 198 | 2.5 | 254 | 3.2 | 4.2 |
| | ≥90 | 400 | 2.4 | 37 | 0.3 | 18.3 | 24 | 0.3 | 34 | 0.4 | 1.7 |
| Toxic agent | Non-opioid analgesics, anti-pyretics and anti-rheumatics | 6 51 | 3.9 | 730 | 5.6 | 8.0 | 383 | 4.8 | 365 | 4.6 | 0.9 |
| | Anti-epileptic, sedative-hypnotic and anti-Parkinsonism drugs | 4685 | 28.3 | 4109 | 31.5 | 7.0 | 2423 | 30.5 | 2469 | 31.1 | 1.3 |
| | Other psychotropic drugs | 11 72 | 7.1 | 1186 | 9.1 | 7.3 | 701 | 8.8 | 697 | 8.8 | 0.0 |
| | Other drugs | 2113 | 12.8 | 273 | 2.1 | 41.6 | 143 | 1.8 | 234 | 2.9 | 7.3 |
| | Unspecified drugs | 7 908 | 47.8 | 6737 | 51.7 | 7.8 | 4288 | 54.0 | 4173 | 52.6 | 2.8 |
| Classification of mental disorder | Schizophrenia | 1394 | 8.4 | 2210 | 17.0 | 26.0 | 1133 | 14.3 | 1154 | 14.5 | 0.6 |
| | Mood disorders | 3845 | 23.3 | 584 | 4.2 | 40.9 | 3006 | 37.9 | 3070 | 38.7 | 1.6 |
| | Organic mental disorders | 260 | 1.6 | 178 | 1.4 | 1.6 | 114 | 1.4 | 127 | 1.6 | 1.6 |
| | Mental disorders due to psychoactive substance use | 451 | 2.7 | 251 | 2.7 | 0.0 | 260 | 3.3 | 271 | 3.4 | 0.6 |
| | Disorders of personality and behaviour | 261 | 1.6 | 461 | 3.5 | 12.1 | 210 | 2.6 | 217 | 2.7 | 0.6 |
| | Other mental disorder | 11 90 | 7.2 | 2042 | 15.7 | 26.9 | 1012 | 12.7 | 990 | 12.5 | 0.6 |
| | Not known | 9128 | 55.2 | 2309 | 17.7 | 84.6 | 2203 | 27.8 | 2109 | 26.6 | 2.7 |
| Level of consciousness on admission | Alert | 5299 | 32.1 | 2909 | 22.3 | 22.2 | 1983 | 25.0 | 1949 | 24.6 | 0.9 |
| | Dull | 3746 | 22.7 | 3280 | 25.2 | 5.9 | 1866 | 23.8 | 1919 | 24.2 | 0.9 |
| | Somnolence | 3416 | 20.7 | 2963 | 22.7 | 4.9 | 1846 | 23.3 | 1850 | 23.3 | 0.0 |
| | Coma | 4068 | 24.6 | 3883 | 29.8 | 11.7 | 2223 | 28.0 | 2220 | 28.0 | 0.0 |
| Charlson comorbidity index | 0 | 12 251 | 74.1 | 11 203 | 85.9 | 29.8 | 6775 | 85.3 | 6640 | 83.6 | 4.7 |
| | 1 | 2624 | 15.3 | 1352 | 10.4 | 14.7 | 859 | 10.8 | 929 | 11.7 | 2.8 |
| | 2 | 994 | 6.0 | 327 | 2.5 | 17.4 | 215 | 2.7 | 247 | 3.1 | 2.4 |
| | ≥3 | 760 | 4.6 | 156 | 1.2 | 20.4 | 89 | 1.1 | 122 | 1.5 | 3.5 |
classified into three categories (low, medium and high volume), with approximately equal numbers of patients in each group.

Outcome
The primary outcome was readmission to the same hospital due to repeated drug overdose.

Statistical analyses
We conducted one-to-one matching between the psychiatric intervention group and unexposed group based on the estimated propensity score of each patient. This approach avoided treatment selection bias, which is inherent in observational data analysis. In this approach, every patient in the intervention group was matched with a patient in the unexposed group based on the estimated propensity score, the probability of undergoing the intervention calculated using the observed potential confounders. The matched patients constituted two groups with similar characteristics, which resembled a randomised experiment-like situation. To estimate the propensity score, we fitted a logistic regression model with receipt of the psychiatric intervention as the outcome variable and the following as independent variables: age; gender; ICD-based information on toxic agents (non-opioid analgesics, anti-pyretics and anti-rheumatics [T39]; anti-epileptic, sedative, hypnotic and anti-Parkinsonian drugs [T42]; other psychotropic drugs [T43]; other drugs [T36–38, T41, T44–T49]; and unspecified drugs [T50]); ICD-based diagnoses of mental disorders (schizophrenia [F2]; mood disorders [F3]; organic mental disorders [F0]; mental disorders due to psychoactive substance use [F1]; disorders of personality and behaviour [F6]; and other mental disorder); Japan Coma Scale on admission; CCI; tracheal intubation; haemodialysis; type of hospital (academic or non-academic); hospital volume category and fiscal year of discharge. The C-statistic was calculated to evaluate the goodness of fit.

We conducted one-to-one matching between the psychiatric intervention and unexposed groups using nearest-neighbour matching within a calliper. One unexposed patient with the closest propensity score was selected for each intervention patient – provided that the difference in propensity score was within a certain amount (a calliper). We set a calliper as 0.20 of the standard deviation of the estimated propensity scores to achieve good balance between the intervention and unexposed groups. We used standardised differences to compare the prevalence of characteristics between the two groups. An absolute standardised difference of >10 has been suggested as signifying meaningful imbalance. We performed a chi-squared test to compare the proportions of readmission between the psychiatric intervention and unexposed groups among the propensity-matched patients. Logistic regression analysis for readmission was performed to calculate the odds ratio and 95% confidence interval (CI) of the psychiatric intervention group with respect to the unexposed group. We performed subgroup analysis on propensity-matched patients by age group. The threshold for significance was $P<0.05$. All statistical analyses were conducted using IBM SPSS Statistics, version 22.0 (IBM SPSS, Armonk, New York, USA).

Results
We identified 29,564 eligible patients from 368 hospitals during the study period; they comprised the psychiatric intervention group ($n=13,035$; 44.1%) and unexposed group ($n=16,529$; 55.9%). In total, 1961 patients (6.6%) required repeated admission due to drug overdose. Using one-to-one propensity score matching, we obtained 7938 pairs of the psychiatric intervention and unexposed groups. The C-statistic for goodness of fit was 0.768. Table 1...
shows the demographic characteristics of all patients (n=29 564) and the propensity score-matched patients (n=15 876). Patients in the psychiatric intervention group were more likely to have the following characteristics: be younger and female; have schizophrenia, mood disorder, or personality or behaviour disorders; take psychotropic drugs during their overdose episode; have a worse consciousness level; undergo tracheal intubation and haemodialysis; and be discharged after 2012. Academic hospitals and higher volume hospitals were more likely to perform psychiatric interventions. After propensity score matching, the patient distributions were closely balanced between the two groups.

Table 2 shows the proportion of readmissions due to drug overdose in each subgroup in the propensity score-matched groups. In the matched patients, 1304 patients (8.2%) required repeated admission due to drug overdose. Patients who were younger females, had personality disorders and took other psychotropic drugs during their overdose episode were more likely to be readmitted as a result of drug overdose. Patients who were admitted to higher volume hospitals or discharged before 2011 were also more likely to be readmitted.

The propensity score-matched analysis showed a significant difference in readmission due to drug overdose between the psychiatric intervention and unexposed groups (7.3% v. 9.1% respectively; P<0.001). Logistic regression analysis showed that the psychiatric intervention group had a significantly lower proportion of readmission through drug overdose than the unexposed group (adjusted odds ratio 0.79; 95% CI 0.71–0.89; P<0.001; Table 3).

| Table 2 | Proportions of readmission due to overdose in each subgroup in the propensity-matched patients (n=15 876) |
|----------|----------------------------------------------------------------------------------------------------------------|
|          | No. of patients | Readmission | %           |
| Total    | 15 876          | 1304        | 8.2         |
| Female   | 11 196          | 1032        | 9.2         |
| Age, years |                  |             |             |
| 12–19    | 1073            | 91          | 8.5         |
| 20–29    | 3885            | 358         | 9.3         |
| 30–39    | 3889            | 389         | 10.0        |
| 40–49    | 3117            | 278         | 8.9         |
| 50–59    | 1577            | 109         | 6.9         |
| 60–69    | 1097            | 52          | 4.7         |
| 70–79    | 758             | 20          | 2.6         |
| ≥80      | 510             | 7           | 1.4         |
| Toxic agent |                |             |             |
| Non-opioid analgesics, anti-pyretics and anti-rheumatics | 748 | 35 | 4.7 |
| Anti-epileptic, sedative-hypnotic and anti-Parkinsonism drugs | 4892 | 395 | 8.1 |
| Other psychotropic drugs | 1398 | 121 | 8.7 |
| Other drugs | 377 | 19 | 5.0 |
| Unspecified drugs | 8461 | 734 | 8.7 |
| Classification of mental disorder | | | |
| Schizophrenia | 2287 | 206 | 9.0 |
| Mood disorders | 6076 | 507 | 8.3 |
| Organic mental disorders | 241 | 10 | 4.1 |
| Mental disorders due to psychoactive substance use | 531 | 28 | 5.3 |
| Disorders of personality and behaviour | 427 | 57 | 13.3 |
| Other mental disorders | 2002 | 154 | 7.7 |
| Not known | 4312 | 342 | 7.9 |
| Level of consciousness on admission | | | |
| Alert | 3932 | 334 | 8.5 |
| Dull | 3805 | 318 | 8.4 |
| Somnolence | 3696 | 317 | 8.6 |
| Coma | 4443 | 335 | 7.5 |
| Charlson comorbidity index | | | |
| 0 | 13,415 | 1164 | 8.7 |
| 1 | 1788 | 103 | 5.8 |
| 2 | 462 | 27 | 5.8 |
| ≥3 | 211 | 10 | 4.7 |
| Tracheal intubation | 1603 | 98 | 6.1 |
| Haemodialysis | 208 | 12 | 5.8 |
| Academic hospital | 6517 | 529 | 8.1 |
| Hospital volume groups, per year | | | |
| Low (≤38) | 4935 | 358 | 7.3 |
| Medium (39–84) | 5339 | 463 | 8.7 |
| High (≥85) | 5602 | 483 | 8.6 |
| Fiscal year of discharge | | | |
| 2010 | 4873 | 572 | 11.7 |
| 2011 | 5908 | 507 | 8.6 |
| 2012 | 5095 | 225 | 4.4 |
Subgroup analysis showed that psychiatric intervention was significantly associated with lower readmission in two age groups – patients in their 20s and 40s (Table 4).

**Discussion**

Using a national in-patient database in Japan, this study compared repeated admission due to drug overdose between a psychiatric intervention and an unexposed group. Only 44% of the admitted patients underwent psychiatric intervention. A propensity-matched analysis demonstrated that the proportion of repeated admission through drug overdose was lower in the psychiatric intervention than in the unexposed group. Although not statistically significant for some age groups, the results were consistent across the various age groups. Psychiatric intervention was associated with lower readmission in younger subgroups, which is consistent with the findings of other reports.

Several studies have investigated the effect of psychiatric intervention before discharge on preventing repetition of self-harm. However, the generalisability of those reports was limited because they were based on small sample sizes or were restricted to data from highly advanced institutions with specialist self-harm teams. One strength of the present study was the generalisability of the general in-patient population, being based on nationwide data from various types of hospitals.

Previous investigations have shown mixed results on the effect of psychiatric intervention in preventing repetition of self-harm. However, the generalisability of those reports was limited because they were based on small sample sizes or were restricted to data from highly advanced institutions with specialist self-harm teams. One strength of the present study was the generalisability of the general in-patient population, being based on nationwide data from various types of hospitals.

In conclusion, our study demonstrated that psychiatric intervention following discharge was associated with reduced risk of readmission, which suggests that such interventions are effective. However, because we were unable to assess the effect of intervention by other specialists, our findings may not apply to hospitals without consultation liaison services provided by psychiatrists.

Several limitations of this study warrant consideration. First, the database used did not include the severity of mental disorder, which may have influenced the probability of undergoing psychiatric intervention. Second, the recorded diagnoses in administrative claims databases are less well validated than those based on prospective cohorts or registries. Third, a large proportion of unspecified drugs may have caused confounding bias and led to underestimating the true effect of the intervention.

In conclusion, our study demonstrated that psychiatric intervention by psychiatrists before discharge was associated with reduced risk of repeated admission to emergency centres. These findings indicate the importance of psychiatric intervention for drug overdose patients admitted to emergency centres in preventing repeated admission.

### Table 3 Proportions of readmission due to overdose in the propensity-matched group (n=15,876)

| Unexposed group (n=7938) | Psychiatric intervention group (n=7938) | Odds ratio (95% CI) |
|-------------------------|----------------------------------------|---------------------|
| n | % | n | % | P |
| 722 | 9.1 | 582 | 7.3 | <0.001 | 0.79 (0.71-0.89) |

The proportion of readmission within 1 year (4.4%) was lower than the proportions of repeated self-harm (16%) reported in one systematic review. A recent systematic review of brief contact interventions also found a higher rate of repeated self-harm (intervention 9.8%; unexposed 11.1%). The reviewed studies identified repeated episodes using various methods such as the use of catchment areas for including patients, follow-up interviews and checking medical records. In the present study, we were able to identify only same-hospital readmission due to overdose, and this was a potential source of underestimation.

Our findings suggest that psychiatric intervention following admission due to drug overdose was associated with reduced readmission. Clinical guidelines from the National Institute for Health and Care Excellence in 2004 and Royal College of Psychiatrists in 2004 recommend that a psychosocial assessment by a trained mental health specialist be carried out for all patients who self-harm. In the present study, interventions by psychiatrists were associated with reduced risk of readmission, which suggests that such interventions are effective. However, because we were unable to assess the effect of intervention by other specialists, our findings may not apply to hospitals without consultation liaison services provided by psychiatrists.

Using a national in-patient database in Japan, this study compared repeated admission due to drug overdose between a psychiatric intervention and an unexposed group. Only 44% of the admitted patients underwent psychiatric intervention. A propensity-matched analysis demonstrated that the proportion of repeated admission through drug overdose was lower in the psychiatric intervention than in the unexposed group. Although not statistically significant for some age groups, the results were consistent across the various age groups. Psychiatric intervention was associated with lower readmission in younger subgroups, which is consistent with the findings of other reports.

### Table 4 Subgroup analysis with proportions of readmission due to overdose in the psychiatric intervention group (n=7938)

| Age, years | Unexposed group | | | Intervention group | |
|------------|----------------|----------------|-------------------|----------------|----------------|----------------|----------------|
| Age, years | No. of patients | Readmission | % | No. of patients | Readmission | % | Odds ratio (95% confidence interval) | |
| 12–19      | 550           | 47           | 8.5 | 523           | 44           | 8.4 | 1.000 (0.98–1.01) | |
| 20–29      | 1978          | 204          | 10.3 | 1877          | 154          | 8.2 | 0.036 (0.02–0.05) | |
| 30–39      | 1955          | 205          | 10.5 | 1934          | 184          | 9.5 | 0.336 (0.31–0.36) | |
| 40–49      | 1559          | 164          | 10.6 | 1558          | 114          | 7.3 | 0.002 (0.00–0.05) | |
| 50–59      | 786           | 62           | 7.9 | 791           | 47           | 5.9 | 0.137 (0.05–0.35) | |
| 60–69      | 530           | 28           | 5.3 | 567           | 24           | 4.2 | 0.478 (0.45–0.49) | |
| ≥70        | 580           | 12           | 2.1 | 688           | 15           | 2.2 | 1.000 (0.48–2.27) | |
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