

Recurrence of Overdose Suicide Attempt Index: A Novel Scoring System for Predicting the Recurrence of Intentional Overdose

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Abstract

Aim: Repeated suicide attempts through intentional overdose are not infrequent, but little is known about the risk factors for intentional overdose. We aimed to investigate risk factors for the recurrence of intentional overdose within 1 year of discharge and to develop an index that predicts recurrence.

Methods: This retrospective observational study included 419 patients admitted to our hospital between 2011 and 2018 because of an intentional overdose. Of them, 43 (10.0%) repeated an overdose within 1 year of discharge. The risk factors with the highest odds ratios in multivariate logistic regression analysis were used to develop an index Recurrence of Overdose Suicide Attempt. The predictive value of this index for recurrence was compared with that of the existing SAD PERSONS scale.

Results: The following variables were significantly associated with recurrence and were included in the index: anxiety and/or insomnia at discharge; use of five or more psychotropic drugs; a neurotic, stress-related, or somatoform disorder; and female sex (odds ratios: 4.24; 5.52; 2.41; and 3.41, respectively). The newly developed index was a significantly better predictor of recurrence than the SAD PERSONS scale (area under the receiver operating characteristics curve, 0.797 vs. 0.668; $p = 0.007$). Sensitivity, specificity, and positive and negative predictive values for Recurrence of Overdose Suicide Attempt > 4 points (out of 6) were 72.1%, 75.8%, 25.4%, and 96.0%, respectively.

Conclusion: The novel index can predict the recurrence of intentional overdose with a good negative predictive value and may therefore be a useful screening tool for this high-risk population.

Introduction

Suicide is a major social and medical concern in Japan because of its higher rate compared to that in other major industrialized nations.¹ The incidence of suicide attempts has been reported to be more than 10 times that of suicide,² imposing a significant economic and medical burden in emergency medicine. The main predictor of future suicidal behavior is a previous suicide attempt.³⁻⁵ A strategy to reduce the recurrence of suicide attempts is needed.

In recent years, intentional drug overdose has become a widely used method for attempting suicide and therefore a serious issue in Japan.^{6,7} According to a nationwide survey, the proportion of suicide attempts that involve intentional overdose has more than doubled over the last decade.⁸ The recurrence of intentional overdose has been reported as 17%–38%,^{4,9} but little is known about the risk factors for this. Historically, the SAD PERSONS scale has been used as a screening tool for suicide risk.¹⁰ However, its sensitivity for repeat attempts is very low,¹¹ and it has not been validated for the Japanese population. There is therefore a need for a new screening tool to evaluate the risk of recurrence so that people at high risk can be identified.

The aim of this study was to investigate the risk factors for the recurrence of an intentional overdose within 1 year of discharge and to develop a scoring system for predicting recurrence.

Methods

Study setting and patients

This retrospective observational study included patients admitted to Fujita Health University Hospital between 2011 and 2018 because of an intentional drug overdose. The hospital is a tertiary medical center located in Toyoake city and is the largest hospital in Japan. Patients were excluded if their suicide attempt combined overdose with other means, such as fall, burning, or carbon monoxide poisoning. Intentional drug overdose was defined as the intentional self-administration of more than twice prescribed dose of a medicine and/or over-the-counter drug at one time.⁴ Recurrence was defined as a repeated episode of an intentional overdose that required for hospitalization within 1 year of discharge.⁴ Recurrence was detected from medical record when they transferred to the hospital. As the hospital is the only tertiary medical center in the covered medical area, all patients in the medical area who called ambulance for intentional overdose were transferred to the hospital.

The patients were admitted via the emergency department and were initially treated by emergency physicians. When the patient was awake and able to talk, he or she was referred to a psychiatrist. The discharge and follow-up plans were decided by the emergency physicians and psychiatrists.

Data

The data collected retrospectively from electronic medical charts included the patient's age, sex,¹² past medical history,⁴ number of combinations of psychotropic medications,¹³⁻¹⁵ any previous suicide attempt within 5 years,⁹ whether there was an organized plan for the patient,¹⁶ the presence of anxiety and/or insomnia while in the hospital,¹⁷ and whether the patient had family and/or social support. We considered patients have an organized plan when they have persistent thought of death and planning to collect medications for overdose and/or when psychiatrists judged not impulsive. The diagnosis of any psychotic disorder was made in accordance with the International Classification of Diseases, 10th revision (ICD-10).¹⁸

Statistical analysis and development of the index

Continuous variables are presented as mean \pm standard deviation or median with interquartile range, depending on their distributions, and categorical variables are summarized as n (%). The univariate analysis of differences between the recurrence and non-recurrence groups used two-tailed unpaired t-tests for continuous variables and chi-square tests for discrete variables. Logistic regression analysis models were used to assess the factors significantly associated with the recurrence of intentional overdose. Variables that were statistically significant and psycho-socially plausible were entered into a logistic multivariable model. The variables that were statistically significant in the multivariate logistic regression analysis were combined to develop an index for predicting recurrence, the Recurrence of Overdose Suicide Attempt index (ROSA). Receiver operating characteristic (ROC) analysis was used to compare the predictive ability of ROSA scores was compared with that of using the SAD PERSONS scale.¹⁰ The optimal cutoff was defined as the point of the maximum sum of sensitivity and specificity results.

The statistical analyses were performed with EZR (Saitama Medical Center, Jichi Medical University, Saitama, Japan), which is a graphical user interface for R (The R Foundation for Statistical Computing, Vienna, Austria).¹⁹

Results

Patient background and factors associated with recurrence

In total, 419 patients were included in this study. The mean age was 39 ± 17 years, 306 (73%) were women, 159 (38%) had an organized plan, and 333 (79%) had previously been diagnosed with a psychiatric disorder. The most common components of the medications used for the overdose were medicines prescribed by medical institutions (81%) and over-the-counter drugs (19%) (Table 1).

Of the 419 patients, 43 (10%) repeated an intentional overdose within 1 year of discharge. Table 1 presents a comparison of this group with the remaining patients. Five variables were associated with overdose recurrence in the univariate analyses: female sex ($P = 0.010$), a previous suicide attempt ($P = 0.001$), the number of combinations of psychotropic medications ($P < 0.001$), positive anxiety and/or insomnia symptoms at hospital discharge ($P < 0.001$), and the presence of an anxiety disorder (i.e., an ICD-10 classification of F4) ($P < 0.001$).

Development of the ROSA index

To convert the number of psychotropic medications taken to a categorical variable, ROC analysis was used to determine the optimal cutoff for predicting the recurrence of an intentional overdose (Fig. 1). This showed that the optimal cutoff was ≥ 5 drugs. Multivariable logistic regression models showed that four variables were associated with recurrence: anxiety and/or insomnia symptoms at hospital discharge (OR, 4.24; 95%CI, 1.76–10.2; $P = 0.001$), the use of five or more psychotropic medications (OR, 5.52; 95%CI, 2.38–12.8; $P < 0.001$), diagnosis of and ICD-F4 anxiety disorder (OR, 2.41; 95% CI, 1.10–5.27; $P = 0.028$), and female sex (OR, 3.41; 95%CI, 0.98–11.9; $P = 0.054$) (Table 2). Each of these variables was converted into a simple score based on the coefficient of variation. Thus, the ROSA index was defined as the total of the four-component score that included female sex (1 points), anxiety and/or insomnia symptoms at discharge (2 points), use of five or more psychotropic drugs (2 points), and a diagnosis of an anxiety disorder (1 points), with a total score in the range 0 to 6 (Table 3).

Comparison between ROSA and the SAD PERSON scale

ROC analysis showed that the ROSA score was superior to the SAD PERSONS scale score for predicting the recurrence of an intentional overdose. The areas under the ROC curve were 0.797 and 0.668, respectively ($p = 0.007$). Using optimal cutoff values of ≥ 4 for ROSA and ≥ 5 for the SAD PERSONS scale, the sensitivities were 72.1% vs. 74.4% and specificities 75.8% and 50.8% (Fig. 2 and Table 4). The positive and negative predictive values for ROSA ≥ 4 were 25.4% and 96.0%, respectively. The recurrence rate for patients with ROSA ≥ 4 points was 25.4% (Fig. 3).

Discussion

Suicide is a major national social issue in Japan, and repeated intentional overdoses pose a significant economical and medical burden for both emergency medicine and psychiatry. In this study, we quantitatively evaluated the risk factors for the recurrence of an intentional overdose within 1 year of discharge and developed a novel index for predicting such a recurrence.

The results showed that recurrence was significantly associated with female sex, use of five or more psychotropic drugs, a diagnosis of an ICD-F4 anxiety disorder, and anxiety and/or insomnia symptoms at hospital discharge, but not with having an organized plan, a previous suicide attempt, the availability of family or social support, or a diagnosis of a personality disorder (ICD-F6). Intentional overdose is more common in women than in men,²⁰ and our results suggested that women are proportionately more likely than men to repeat an overdose.

We examined whether the recurrence of an intentional overdose was associated with various types of psychiatric disorder. There was no statistically significant association with the diagnosis of a personality disorder. This may be because of the very low incidence of personality disorders in our cohort. Further evaluation is needed of the risk for further suicide attempts with each type of psychiatric disorder.

In contrast, insomnia and/or anxiety symptoms at discharge were associated with the recurrence of an intentional overdose. These symptoms may indicate an uncontrolled underlying psychiatric disorder. The actual impact of psychiatric intervention on preventing future suicide attempts remains controversial,^{21,22} but our findings provide an insight into the future management of suicide prevention in this high-risk subgroup. In particular, it is possible that treating insomnia and anxiety could prevent further suicide attempts. There was no significant association between a previous suicide attempt and a future episode, and many people who committed suicide were not treated despite having a mental disorder.²³ This suggests that the focus should be on a patient's current symptoms rather than on his or her past medical history.

Our finding that the use of multiple psychotropic medications was associated with the recurrence of an intentional overdose provides further evidence that the mental symptoms of patients who overdosed may not have been appropriately managed. This finding is consistent with a previous report that lower doses of prescribed benzodiazepine were associated with a lower risk of a subsequent overdose.²¹ Easy access to a large amount of medication, the development of drug dependency, side effects associated with polypharmacy, and inadequate assessment of adherence may also synergistically increase the likelihood of a future overdose.^{8,25} This suggests that a repeated overdose may be iatrogenic to some extent. Recently, the role of pharmacist for the prevention of polypharmacy is getting more attention.⁸ Pharmacist-level action, such as questioning the prescription and providing information to the prescribing doctors, may be effective in reducing polypharmacy and reducing these iatrogenic overdoses.⁸ The provision of social and psychological support in addition to psychiatric treatment to patients using multiple psychotropic drugs may also help prevent further suicide attempts.^{24,26,27} The effect of such risk-stratified interventions should be evaluated in the future.

Identifying individuals who are at risk of future suicide attempts is of high clinical importance, providing the opportunity for the delivery of timely health services that may prevent an individual from completing suicide. The SAD PERSON scale, developed in the United States in 1983 as a tool to assess suicide risk following an episode of self-harm, has been used in numerous countries around the world.¹⁰ This commonly used scale has been widely implemented in clinical settings despite a lack of evidence supporting its use.¹¹ In particular, it has not been validated for the Japanese population. In this study, we proposed the ROSA index, which is simple and a better predictor of a repeated overdose. After hospitalization, patients often transiently lose their suicidal ideation.²⁸ In previous studies, the denial of suicide intention at recovery was associated with a somewhat increased risk of suicide attempt after discharge.⁴ These findings may also be the reason that the SAD PERSON scale is less effective for our population. In contrast, the ROSA index showed a high negative predictive value, which is essential for a screening tool.

Limitations

This study had some limitations. First, because of its single-center analysis, there may have been selection bias which restricted to inhabitant of the suburban area in Japan. Indeed, the percentages of patients with the various psychiatric disorders differed from those in previous studies. In addition, because of the sample size, we only perform derivation study of ROSA score, which is not suitable to evaluate the efficacy of ROSA score over SADPERSON scale. External validity should be evaluated in the future trial. Second, the recurrence of overdose may be undervalued, because it is possible that some of those who repeated an overdose were admitted to another hospital without notice. However, our hospital is the only tertiary medical center in the covered medical area, and all patients who overdosed and called ambulance in the medical area will transferred to our hospital. External validation is needed. Third, the severity of insomnia and anxiety symptoms were not considered because of retrospective nature of this study. These symptoms should be evaluated quantitatively in a future prospective multicenter study.

Conclusion

The ROSA index provides a novel scoring system for assessing the possibility of a repeated overdose with reasonable sensitivity and a good negative predictive value. It may be a useful screening tool for identifying individuals with a high risk of a future suicide attempt even when there is no suicidal ideation at discharge. Additional multicenter studies are needed for the further validation of this index.

Abbreviations

ICD-10: International Classification of Diseases, 10th revision

ROSA: Recurrence of Overdose Suicide Attempt index

Declarations

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Authors' contributions

All authors MH and DK conceptualized and designed the study. MH collected the data. MH, DK and HT responsible for data analyses. The first draft was written by MH. DK, KT, HT, SY, AH provided comments and review of draft analyses. All authors read and approved the final manuscript.

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Availability of data and materials

The data sets used and/ or analyzed during the current study are available from the corresponding author on reasonable request.

Ethics approval and consent to participate

This study was approved by the ethics committee of the Fujita Health University Hospital

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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Tables

Table 1. Comparison of characteristics between the patients who repeated an intentional overdose within 1 year of discharge (Recurrence) and those who did not (No recurrence)

| | Total (N =419) | Norecurrence (n=376) | Recurrence (n=43) | P |
|--|-------------------|-------------------------|----------------------|--------|
| Age, y, mean±SD | 39.0±17.0 | 39.3±17.3 | 36.5±12.5 | 0.303 |
| Female sex, <i>n</i> (%) | 306 (73) | 267 (71) | 39 (91) | 0.006 |
| Organized plan, <i>n</i> (%) | 159 (38) | 237 (63) | 23 (54) | 0.247 |
| Previous suicide attempt, <i>n</i> (%) | 248 (59) | 212 (56) | 36 (84) | <0.001 |
| Familial/social support, <i>n</i> (%) | 270 (64) | 245 (65) | 25 (58) | 0.402 |
| Anxiety or insomnia at discharge, <i>n</i> (%) | 220 (53) | 185 (49) | 35 (82) | <0.001 |
| Number of overdosed psychotropic medications, median(IQR) | 4(2–6) | 4(1–5) | 5(5–6) | <0.001 |
| Previous diagnosis of psychotic disorders, <i>n</i> (%) | 333 (79) | 293 (78) | 40 (93) | 0.017 |
| F2: schizophrenia, <i>n</i> (%) | 44 (11) | 37 (10) | 7 (16) | 0.192 |
| F3: mood disorders, <i>n</i> (%) | 188 (45) | 172 (46) | 16 (37) | 0.333 |
| F4: neurotic, stress-related, and somatoform disorders, <i>n</i> (%) | 69 (16) | 54 (14) | 15 (35) | 0.002 |
| F6: disorders of adult personality and disorders, <i>n</i> (%) | 9 (2) | 9 (2) | 0 (0) | 0.607 |
| Other, <i>n</i> (%) | 23 (5) | 21 (6) | 2 (5) | |

IQR,interquartile range; F2, F3, F4, and F6, classifications according to the International Classification of Diseases, 10th revision.

Table 2. Risk factors for the recurrence of an intentional overdose within 1 year of discharge

| | Univariate | | Multivariate | | |
|-------------------------------|-----------------|---------|--------------|-----------------|---------|
| | OR(95%CI) | P value | coefficient | OR(95%CI) | P value |
| age | 0.99(0.97-1.01) | 0.303 | | | |
| sex | 3.98(1.39-11.4) | 0.01 | 1.23 | 3.41(0.98-11.9) | 0.054 |
| organized plan | 1.48(0.79-2.80) | 0.224 | | | |
| Previous suicide attempt | 3.98(1.73-9.17) | 0.001 | | 1.52(0.61-3.79) | 0.375 |
| Familial/social support | 0.74(0.39-1.40) | 0.364 | | | |
| Anxiety or insomnia | 4.52(2.04-9.99) | <0.001 | 1.44 | 4.24(1.76-10.2) | 0.001 |
| Psychotropic medications (≥5) | 6.49(2.91-14.5) | <0.001 | 1.71 | 5.52(2.38-12.8) | <0.001 |
| Anxiety disorder (ICD-10 F4) | 3.19(1.6-6.37) | <0.001 | 0.88 | 2.41(1.10-5.27) | 0.028 |

OR, odds ratio; CI, confidence interval; ICD-10, International Classification of Diseases, 10th revision.

Table 3. Factors included in the ROSA index and their associated scores

| | Score |
|---|-------|
| Female sex | 1 |
| Anxiety and/or insomnia at discharge | 2 |
| Using more than five combinations of psychotropic medications | 2 |
| Diagnosis of anxiety disorders | 1 |

ROSA, Recurrence of Overdose Suicide Attempt index.

Table 4. Receiver operating characteristic analysis comparing the ability of the ROSA and SAD PERSONS indexes to predict the recurrence of an intentional overdose within 1 year of discharge

| | ROSA (cutoff: 4) | SAD PERSONS scale (cutoff: 5) | P |
|-------------|--------------------|-------------------------------|-------|
| AUC(95%CI) | 0.797(0.725-0.868) | 0.668 (0.587-0.749) | 0.007 |
| Sensitivity | 72.1% | 74.4% | |
| Specificity | 75.8% | 50.8% | |

AUC, area under the curve; ROSA, Recurrence of Overdose Suicide Attempt index

Figures

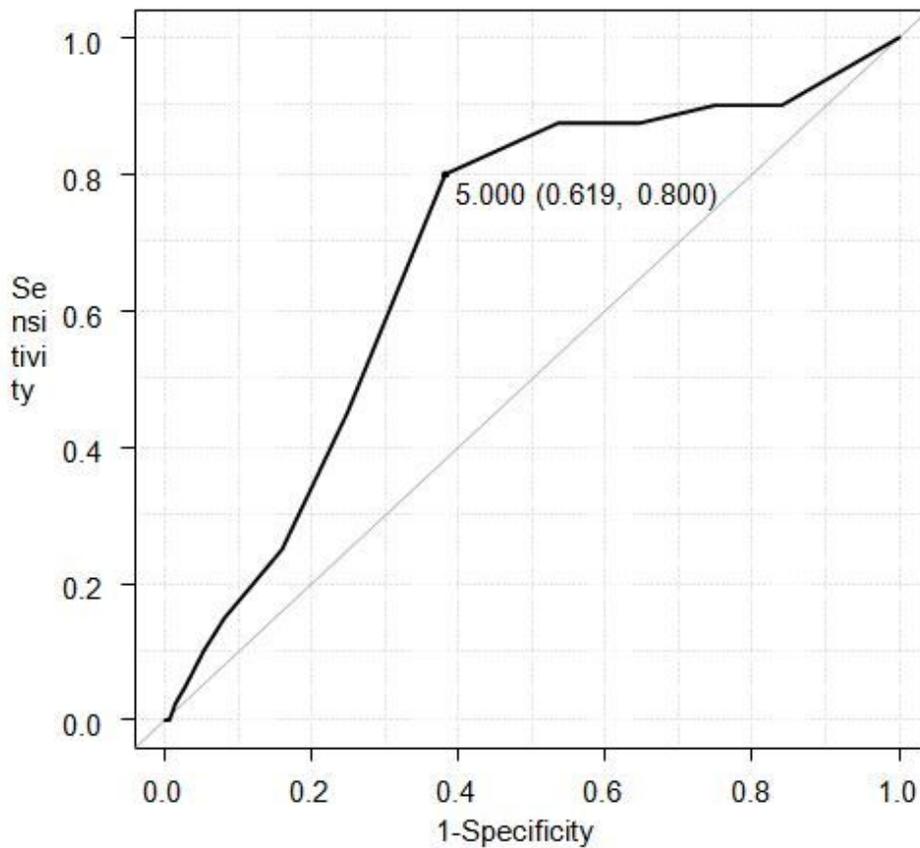


Figure 1

Receiver operating characteristic curve for the number of psychotropic medications used by the patients as a predictor of the recurrence of an intentional overdose within 1 year of discharge. The area under the curve was 0.680 (95% confidence interval, 0.605–0.769). The optimal cutoff value for predicting recurrence was ≥ 5 drugs.

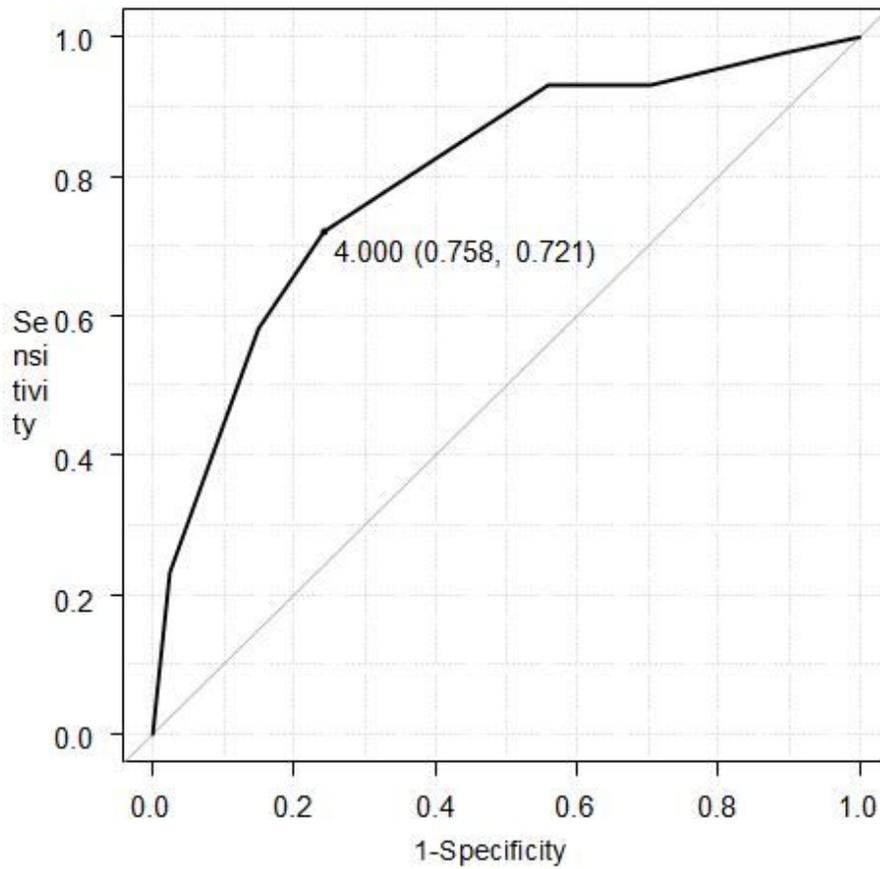


Figure 2

Receiver operating characteristic curve for the ROSA score as a predictor of the recurrence of an intentional overdose within 1 year of discharge. The area under the curve was 0.797 (95% CI, 0.725-0.868). With a cutoff of ≥ 4 points, the sensitivity for predicting recurrence was 72.1% and the specificity was 75.8%. ROSA, Recurrence of Overdose Suicide Attempt index

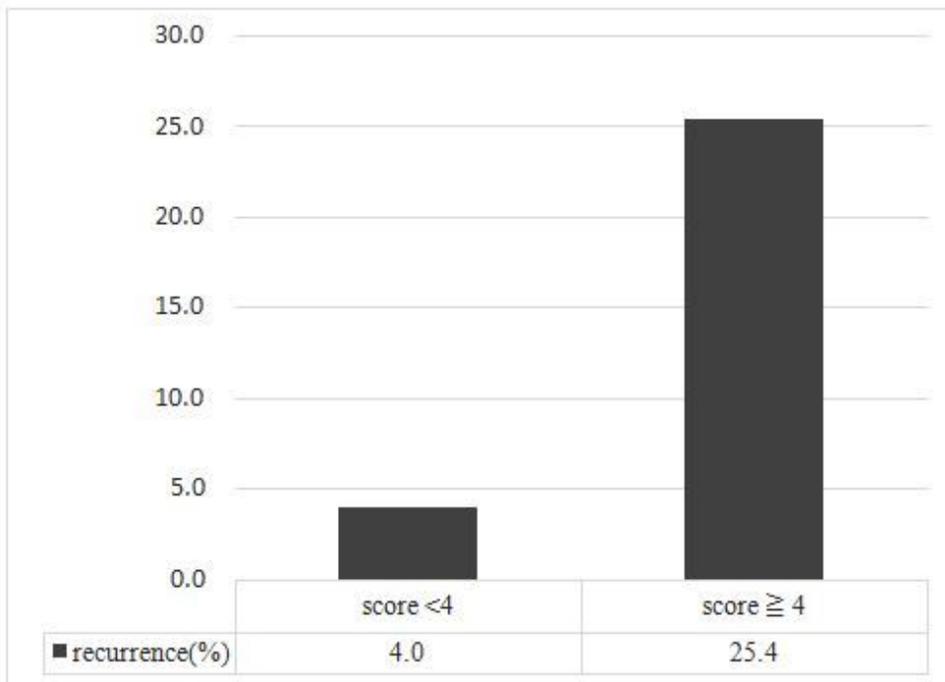


Figure 3

Relationship between ROSA scores and the rate of recurrence of an intentional overdose within 1 year of discharge. Patients with a ROSA score of less than 4 points had a recurrence rate of 4.0%, while those with a score of ≥ 4 points had a recurrence rate of 25.4%. ROSA, Recurrence of Overdose Suicide Attempt index