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Research Paper

Post-discharge suicide among high-risk psychiatric inpatients: Risk factors and warnings signs

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ABSTRACT

Background: The present study explored the predictive value of a novel suicide risk assessment with regard to suicide deaths within three years of discharge from an acute inpatient unit. The contributions of the different components of the assessment to overall determination of suicide risk were also explored.

Methods: A total of 380 acute psychiatric inpatients were analysed in a 3- year prospective study. At admission, the physician on duty performed a suicide risk assessment based on national guidelines and clinical state variables. A dichotomous variable reflecting high/low suicide risk level was determined by the clinician and recorded in the chart. Information on the number and causes of deaths was obtained from the Norwegian Cause of Death Registry.

Results: Eleven (2.9%) patients died by suicide within three years after discharge, eight high-risk patients and three low risk patients (OR = 8.7, 95% CI: 2.2–33, $p = 0.002$). In multivariable analysis, recent suicidal ideation (SI) (OR = 3.6, 95% CI: 1.5–8.7, $p = 0.004$), and affective disturbance (OR = 4.3, 95% CI: 1.5–12.6, $p = 0.008$) were significantly associated with rating of high suicide risk.

Limitations: The sample size was rather small, which in conjunction with the low base rate of suicide, reduces power and limits generalizability of the findings.

Conclusion: We found that a novel suicide risk assessment at admission to an acute psychiatric service was a powerful predictor of suicide post-discharge. The components of the risk assessment that were statistically significant with high suicide risk were affective disturbance and recent SI.

1. Introduction

Most suicides occur in individuals with mental illness, and almost all psychiatric disorders are associated with increased suicide-mortality (Cho et al., 2016; Harris and Barraclough, 1997; Yeh et al., 2019). Individuals with mental illness who have been discharged from psychiatric hospitals may be at greater risk for suicide than other mentally ill persons (Chung et al., 2017; Haglund et al., 2019; Honkonen et al., 2008; Isometsa et al., 1993; Madsen et al., 2020; Madsen and Nordentoft, 2013; Nordentoft et al., 2016; Prestmo et al., 2020).

During inpatient stay or right after discharge, patients in an acute psychiatric inpatient service have a suicide rate 100 times the global rate, which exceeds any comparable population (Chung et al., 2017; Prestmo et al., 2020; Qin and Nordentoft, 2005). Chung et al. (2017) found in a large review the highest suicide rates (100 times the global rate) during the first three months after discharge. Further, the suicide rates were 60 times the global rate in studies with follow-up 3 to 12 months after discharge, and in studies, with follow-up for 5 to 10 years, post-discharge had rates 30 times the global rate (Chung et al., 2017). These figures represent a significantly higher and more enduring risk

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than was previously believed; as stated by the authors, the three-month post-discharge rates are more than three times the suicide rates presented in comparable studies (Chung et al., 2017; Walsh et al., 2015).

Moreover, several studies have indicated a gradual increase in post-discharge suicide rates, such that the suicide-mortality ratio between psychiatric inpatients and the general population gradually has increased since at least the mid-1980s (Nome and Holsten, 2012; Prestmo et al., 2020).

As such, inpatient psychiatric services are in contact with a substantial number of suicide victims in the months preceding the act (Walby et al., 2018). Therefore, it is critical to identify those individuals at greatest risk within the high-risk population of hospitalized psychiatric patients as the first step toward prevention. Chock et al. also pointed out that patients who die by suicide have a significantly higher number of outpatient, inpatient, and emergency department mental health visits prior to death compared to the general population (Chock et al., 2015).

Therefore, screening depressed patients for suicidal ideation (SI) and intent has been recommended for routine in psychiatry practice (Conway et al., 2017; Luoma et al., 2002; Valuck et al., 2012). However, the utility of this practice has been questioned because of the lack of predictive value of different scales and the tendency to yield false positive results. The 9-item Patient Health Questionnaire (PQH-9) has been shown to be a reliable and valid measure of depressive symptoms severity in a variety of clinical settings (Gilbody et al., 2007; Valuck et al., 2012), but an insufficient assessment tool for suicide risk and SI (Bauer et al., 2013; Louzon et al., 2016; Na et al., 2018). Thus, there is a clear need to explore novel suicide risk assessment methods. This is particularly the case with regard to psychiatric inpatients prior to discharge.

Suicide risk assessments have traditionally included SI and chronic risk factors, like a prior suicide attempt, substance abuse, mental illness, family history of suicide, broken relationship, lack of network, and loss of self-esteem (American Psychiatric Association, 2003; Bolton et al., 2015; The Norwegian Directorate of Health and Social Affairs, 2008). SI is prominent among psychiatric patients and a frequent reason for psychiatric admission (Prestmo et al., 2020; Ries et al., 2009).

However, questions about SI and chronic risk factors probably have low value in predicting the short-term risk of suicide. Many patients that died by suicide denied SI when last questioned about this by their clinician (Berman, 2018; Busch et al., 2003; Stone et al., 2018), while others may not experience SI until minutes before the attempt (Deisenhammer et al., 2009). A recent study from Norway reported that above 50% of acute psychiatric inpatients withheld information on SI during their admission (Hoyen et al., 2021). There has also been an increasing focus on the important difference between chronic risk factors and warning signs for suicide (Rudd et al., 2006). While chronic risk factors indicate the lifetime risk of suicide, warning signs are considered predictive of short-time risk. In particular, the chronic risk factor of past suicide attempts has limited clinical use in predicting death by suicide, as for many patients who die by suicide; the first suicide attempt is the last (Innamorati et al., 2008; Isometsa and Lonnqvist, 1998).

In a prospective multicenter study from the US, where the majority of the sample were inpatients, neither expressed SI nor prior attempts were associated with an acute risk of suicide within one year. Relatively robust predictors were severe anxiety and agitation at admission, insomnia, severe anhedonia, and recent alcohol use problems (Fawcett et al., 1990). Anxiety, agitation, and panic during the inpatient stay were also predictors of suicide. As rated on The Schedule for Affective Disorders and Schizophrenia (SADS) (Endicott and Spitzer, 1978), 79% of these patients met the criteria for severe anxiety and/or agitation. In comparison between patients suffering from major depression who did or did not die by suicide, acknowledged suicidal thoughts were more common among the group who did not die by suicide. Likewise, 78% of the patients who died by suicide denied SI in their last communication about the topic (Fawcett et al., 1990). Thus, the absence or denial of suicidal ideation in this setting can be misleading.

Several authors have suggested similar factors to be important in conceptualizing acute suicide risk. These include: agitation (Ribeiro et al., 2011), sleep disturbance (Bernert and Joiner, 2007; Bernert et al., 2014; Ribeiro et al., 2012), marked irritability (Trivedi et al., 2011), social withdrawal (Duberstein et al., 2004) and severe affective states (Hendin et al., 2010; Maltsberger et al., 2003).

Synthesizing the literature on acute suicidal risk factors, Galynker et al. (2017) introduced a novel suicide risk construct, the Suicide Crisis Syndrome (SCS). The SCS is a pre-suicidal mental state characterized by cognitive and affective dysregulation. The main component of this syndrome is a sense of entrapment, the perceived inability to escape an intolerable situation. Accompanying features include intense affective disturbance, loss of cognitive control, hyperarousal, and social withdrawal (Galynker, 2017). SI is not required for diagnosis, though it may be present. There is robust evidence of the concurrent, predictive, and incremental predictive validity of the SCS. Symptoms of the SCS have shown an association with both recent (Bloch-Elkouby et al., 2021; Calati et al., 2020) and 1–2 month prospective (Bloch-Elkouby et al., 2021; Rogers et al., 2021) suicidal ideation and behaviors, even after accounting for co-occurring SI (Rogers et al., 2021).

Given the burgeoning data on both chronic and acute risk factors, indicating both “the who” and “the when” of suicide risk, it seems useful to consolidate this knowledge into a categorical suicide risk rating. The benefits of such categorical or binary systems lie in their actionability. Complex data can be funneled into a yes/no decision, simplifying and systematizing clinical decision-making (Imbastaro et al., Under Review), particularly in high-risk settings such as psychiatric inpatient services. Indeed, this is how the entire diagnostic system works, including both the ICD and DSM (WHO, APA, 2013).

Nonetheless, in a meta-analysis, Large and colleagues found no factor or combination of factors strongly associated with suicide in the year after discharge. They concluded that suicide risk categorization into low or high suicide risk levels would have no value in terms of decreasing the suicide rate after discharge (Large et al., 2011a). However, they found no study that prospectively examined suicide rates among patients already categorized as high or low risk.

In the present prospective study, we investigated the predictive validity of our own novel suicide risk rating to suicide mortality in a sample of adult patients discharged from an acute psychiatric department in Norway. Data on suicide deaths during a 3-year follow-up period were obtained from the Norwegian Cause of Death Registry, a comprehensive registry for all Norwegian residents.

The aims of the study were to (1) explore the predictive value of the overall suicide risk assessment conducted at intake and (2) to explore the associations between the different components of the assessment (i.e., national guidelines and clinical state variables) to the categorization of high vs. low suicide risk.

2. Methods

2.1. Setting

All patients $\geq$ 18 years admitted to the Department of Acute Psychiatry, St. Olavs University Hospital, Trondheim, Norway, were eligible for inclusion. During the inclusion period, the Department was a 40-bed, locked-door unit divided into four subunits. These units represent the highest level of psychiatric inpatient care available in Norway, except forensic wards. The hospital staff was available 24 h per day. All patients were assigned a primary contact person among the staff, a psychiatrist or specialist in clinical psychology, and a psychiatrist- or psychologist-in-training, responsible for their treatment throughout the admission.

Health care in Norway is publicly funded, available for everyone, and based on catchment areas. The catchment area for the Department covers 310,000 residents living in both urban and rural areas.

The present study is part of a larger study on agitation in acute

psychiatric departments and included patients from September 2011 through March 2012 (https://clinicaltrials.gov/ct2/show/results/NCT01415323). The admission rates did not differ between the winter and summer seasons during 2011 and 2012 (Prestmo et al., 2020).

2.2. Participants

In total, 730 unique patients were eligible to participate, and 380 (52%) gave informed consent. The Regional Ethical Committee limited the number of study participants to a maximum of 400 unique patients. The consent implied acceptance of using data from questionnaires, rating scales, medical records, biological samples, and registries for research as part of the agitation in acute psychiatric departments study. The non-complete inclusion rate was due to discharge before participation could take place (e.g., admission at night and discharge the following morning), lack of competence to consent, and refusal to consent. Within the study sample, 131 (34%) participants had no prior admissions to the department, 273 (72%) had suicidality as a part of the reason for admission, and 38 (10%) had more than one admission during the study period (Prestmo et al., 2020). The index admission was used in patients with multiple admissions.

2.3. Data sources/measures

Demographic information was collected at intake by the physician on duty, who also performed a suicide risk assessment for each patient. A second suicide risk assessment was performed by a psychiatrist or specialist in clinical psychology within 24 h of admission. Information from the suicide risk assessment at intake was used for this study.

Post-discharge, follow-up data on any deaths by suicide were provided by the Norwegian Cause of Death Registry (https://www.fhi.no/en/hn/health-registries/cause-of-death-registry/). Medical chart reviews were performed in the years after inclusion to collect information on relevant clinical variables used to describe the study sample, including the overall suicide risk assessment and the individual risk components of the assessment. The medical chart reviews were performed by the research staff. The procedure for suicide risk assessment and medical chart review is described below.

Demographical and clinical data used to describe the study sample (presented in Table 1) were collected from the patient's medical chart from the index admission. Variables used to address study aim 1 and 2, i.e., information on the overall suicide risk assessment and the individual components of the assessments, were collected from the isolated paragraphs entitled "Suicide Risk Assessment" in patients' intake medical chart from the index admission.

Table 1
Demographic and clinical description of study sample (n = 380).

	N (%)	M (SD)
Demographic variables		
Age		39.8 (15)
Sex (male)	196 (51.6)	
Clinical variables		
Admission status		
Compulsory admission	88 (23.2)	
Voluntary admission	292 (76.8)	
Suicidal thoughts prior to admission (n = 380)	273 (71.8)	
Suicidal attempt prior to admission	46 (12.1)	
Suicidal attempt lifetime	117 (30.7)	
Duration of stay in days		9.0 (9.6)
Diagnosis*		
Affective disorders (F30–39)	132 (34.7)	
Substance abuse disorders (F10–19)	80 (21.1)	
Schizophrenia spectrum disorders (F20–29)	51 (13.4)	
Neurotic stress-related disorders (F40–48)	34 (8.9)	
Personality disorders (F60–69)	34 (8.9)	
Organic disorders (F00–09)	18 (4.7)	
Other disorders	31 (8.2)	

* ICD-10, WHO (1993).

2.3.1. Suicide risk assessment

Prior to data collection, the Department of Acute psychiatry, St. Olavs University Hospital in Trondheim, Norway, introduced new formal procedures for suicide risk assessment. The original procedure appeared less clinically relevant and mainly assessed for chronic risk factors and suicidal thoughts. The new procedures were based on 1) Norwegian *Standardized National guidelines* for the prevention of suicide risk in mental health care (The Norwegian Directorate of Health and Social Affairs, 2008) and 2) *clinical state variables* identified in prior research (Busch et al., 2003; Fawcett et al., 1990; Goodwin, 2003) and corresponding to the clinical experience at the acute department as indicators of acute risk of suicide.

The Norwegian Standardized National guidelines for preventing suicide risk in mental health care were introduced in 2008 (The Norwegian Directorate of Health and Social Affairs, 2008). These guidelines (available at https://helsedirektoratet.no/lists/publikasjoner/attachments/3/nasjonal-faglig-retningslinje-for-forebygging-av-selvmord-i-psykisk-helsevern-is-1511.pdf) identifies *when* patients are to be assessed for risk of suicide (i.e., at first contact with mental health care services) and *what* this assessment must entail in terms of risk factors to be explored. The risk factors to be reviewed include prior suicide attempts (recent and lifetime), substance abuse (recent and lifetime), having a mental illness, suicide in the family, broken relationship, lack of network, and loss of self-esteem. The guidelines also state that every patient in mental health care is to be asked regarding the presence of SI.

The clinical state variables, i.e., warning signs, included extreme anxiety, agitation, affective disturbance, cognitive overload, and insomnia. Further, for the present study, we included supplementary variables covering components of the SCS (see below).

The overall suicide risk was documented in patients' medical charts as being high or low and later collected for the purpose of this study. The evaluation of high versus low suicide risk was made by the physician on duty in consultation with the responsible psychiatrist based on the new procedure. The new procedure stated that the overall assessment should be based on the summary of chronic risk factors, presence/absence of suicidal thoughts/plans, and clinical state variables (e.g., anxiety, agitation, desperation). We also collected information on each of the individual components of the suicide risk assessment (i.e., each of the seven risk factors, SI, and the clinical state variables). The procedure for data collection for the individual suicide risk assessment components is described below.

The procedure for data collection. An independent research assistant (author T.K), blinded for suicide outcome, reviewed the intake medical charts (in the years after inclusion) and specifically reviewed the paragraph on "Suicide Risk Assessment" for descriptions of the individual components of the risk assessment. All identified variables were coded as present, absent, or missing. In day-to-day clinical practice, different words or phrases might be used to describe corresponding states, e.g., desperation or agitation. Prior to data collection, we performed a workshop including all specialists in the Department to examine the different clinical terms specialists might have used to describe warning signs, such as heightened agitation, anxiety, and desperation.

In the years following patient recruitment, a unified clinical construct termed the Suicide Crisis Syndrome (SCS) was introduced (Galynker, 2017; Schuck et al., 2019). The SCS is an acute, hyperaroused, negative affect state, dominated by feelings of entrapment, and has been shown to predict near-term suicidal thoughts and behavior (Schuck et al., 2019). The component of the SCS had similarities with the new formal procedure for suicide risk assessment at the department, but also had essential components that were often described in the suicide risk assessment but not part of the original procedure, i.e., entrapment and social withdrawal. The SCS is currently under review for inclusion in

the text revision of the Diagnostic and Statistical Manual, 5th edition, (DSM-5; APA, 2013). Terminology describing this state was thus included on the list of relevant words and phrases before the medical chart review.

The complete list of these words/phrases is presented in Appendix 1. Each of these phrases corresponds to a variable used for the initial univariate analyses (see Statistical Analyses section).

Variables comprising the suicide risk assessments. The suicide risk assessments performed in the present study were based on two elements as implemented in the department`s formal procedures, as mentioned above. They were collected from the isolated paragraphs entitled "Suicide Risk Assessment" in patients' intake medical records from the index admission:

National guidelines. Traditionally risk factors for suicide are defined by the Norwegian Standardized National Guidelines for the prevention of suicide in mental health care and include a prior suicide attempt (recent and lifetime), substance abuse (recent and lifetime), having a mental illness, suicide in the family, broken relationship, lack of network, and loss of self-esteem (The Norwegian Directorate of Health and Social Affairs, 2008).

Clinical interview. The physician at intake collected information about the patient's current and past suicidal ideation, plans, and behavior. For the purposes of this study, the information in the medical chart was operationalized based on definitions of suicidal ideation and behavior from the Colombia-Suicide Severity Rating Scale (C-SSRS; (Posner et al., 2011)).

Clinical state variables. During the inclusion period (2011/2012), the Department utilized a formal procedure for the suicide risk assessment in which warning signs were included in the assessment procedure. This was based on studies of acute suicide risk factors (Busch et al., 2003; Fawcett et al., 1990), such as extreme anxiety, mood swings, and insomnia. The warning signs included disturbance in arousal, affective disturbance, loss of cognitive control, entrapment, insomnia (recent and lifetime), insomnia lifetime, and social withdrawal.

Altogether there were 18 variables in the two components comprising the suicide risk assessment (National Guidelines: suicide attempt (recent and lifetime), substance abuse (recent and lifetime), suicide in the family, broken relationship, lack of network, and loss of self-esteem. Clinical interview: Suicidal thoughts (recent and lifetime) and self-injury. Clinical State Variables: Disturbance in arousal, affective disturbance, loss of cognitive control, entrapment, insomnia (recent and lifetime), and social withdrawal). The variables were obtained by medical chart review. All identified variables were coded as present, absent, or missing. Because specification of the presence or absence of each criterion was not required in the Departmental risk assessment procedure, there was a good deal of missing values regarding individual assessment components. The number of missing values for all variables is indicated in Table 2.

2.3.2. Diagnosis

Psychiatric diagnoses were obtained from the medical charts. Diagnoses were determined according to the International Classification of Diseases 10th revision (ICD-10) Criteria for Research in a joint consensus meeting of the clinical staff, where at least two specialists in psychiatry or clinical psychology participated, of whom at least one had personally examined the patient.

2.3.3. Follow-up data

Information on the number and causes of death was obtained from the Norwegian Cause of Death Registry at the National Institute of Public Health (https://www.fhi.no/en/hn/health-registries/cause-of-death-registry/). From the information provided by the Norwegian Cause of death registry, deaths by suicide were identified by underlying causes of death coded as X60-X84, Y87.0 (World Health Organization, 1993). The register is known to have high standards for tracing all deaths (Hansen et al., 2001).

The patients were linked to the Registry through their personal identification numbers. Data on suicide mortality was based on all recorded deaths within three years after index admission. The follow-up time was calculated from discharge until death or three years after discharge.

The medical chart of the patients who had died during the follow-up period was reviewed by two psychiatrists, independent of each other, to maximize the accuracy of the determination of the cause of death.

Table 2
Univariate analyses on variables independently associated with high suicide risk.

	OR	95% CI	P-value	Missing N (%)
Sex	1.66	0.65–1.74	0.798	40 (10.5)
Age	0.98	0.96–1.0	0.017	40 (10.5)
National Guidelines:				
Substance abuse lifetime	1.04	0.61–1.75	0.897	84 (22)
Substance abuse recent	1,2	0.70–2.13	0.474	110 (29)
Suicide attempts lifetime	1.17	1.01–1.36	0.043	146 (38.4)
Suicide attempts recent	0.99	0.95–1.04	0.967*	149 (39.2)
Suicide in family	0.64	0.17–2.42	0.509	329 (86.6)
Loss of self-esteem	0.09	0.01–0.61	0.012*	349 (91.8)
Lack of network	1.001	0.39–2.58	0.992	282 (74.2)
Broken relationship	0.58	0.15–2.23	0.493*	310 (81.6)
Clinical Interview:				
Self-injury	4.33	0.94–19.9	0.059	272 (71.6)
Suicidal thoughts lifetime	NA	NA	1	162 (42.6)
Suicidal thoughts recent	3.94	1.93–8.12	0.001	60 (15.8)
Clinical State Variables:				
Social withdrawal	0.36	0.04–3.03	0.564*	346 (91.1)
Disturbance in arousal	1.84	0.99–3.42	0.054	62 (16.3)
Affective disturbance	2.21	1.06–4.58	0.034	65 (17.1)
Loss of cognitive control	1.07	0.55–2.05	0.848	68 (17.9)
Entrapment	4.00	0.21–75.66	0.524*	371 (97.6)
Insomnia lifetime	1.89	0.48–7.5	0.530*	308 (81.1)
Insomnia recent	3.2	1.29–7.94	0.012	151 (39.7)

Notes: Univariate analysis with suicide risk assessment as outcome variable. OR odds ratio, CI confidence interval.
* Fishers Exact Test.

2.4. Ethics

The capacity to provide informed consent was determined by experienced specialists in clinical psychology or psychiatrists. All study participants provided informed consent to participate in the study, including investigators' access to health registers. The study was approved by the Regional Committee for Medical and Health Research Ethics, Central Norway (ref. 2011/137) and conducted according to the Declaration of Helsinki. The study is registered in ClinicalTrials.gov (ref. NCT01415323).

2.5. Statistical analyses

Statistical analyses were performed with the data analysis toolset in Microsoft EXCEL 2015 and the statistical packages SPSS 28 and R 3.4.0 for Windows.

We first calculated the sensitivity, specificity, positive predictive value, and negative predictive value of the overall suicide risk assessment conducted at admission in relation to post-discharge deaths by suicide. Then, we used bivariate analyses (i.e., logistic regression analyses with one independent variable) to assess associations between the variables of the different components of the suicide risk assessment (i.e., National guidelines and clinical state variables) and evaluations of high suicide risk (Table 2). Finally, we built logistic regression models to assess the independent associations between all significant predictors ($p<0.05$) from univariate analyses and evaluations of high suicide risk.

In the first multivariable logistic regression model (n = 152), we included chronic risk factors ($p<0.05$) like age and suicide attempt lifetime. In the second multiple regression analysis, age and suicide attempt lifetime were left out, given the well-documented nature of these risk factors. Furthermore, this improved the statistical power with a larger sample (n = 202) (Table 4). Cases with missing data were excluded from each of the bivariate and multivariable analyses.

3. Results

In total, 380 patients participated in the study, the mean age was 38.9 years (SD 15; range 18–83), and 51.6% were males. The median duration of stay was nine days (SD 9.6; range 1–92 days). The most common primary diagnoses were affective disorders (34.7%), substance use disorders (21.1%), and schizophrenia spectrum disorders (13.4%) (Table 1). Thirty-one percent of the sample had a suicide attempt in their lifetime and 12% in the last month before admission (See Table 1).

Demographic features of the study sample were similar to that of the non-participating patients (N = 350) in the clinical service (mean age 40.7 years (SD 17.3) and 52.8% male), although the diagnostic profile was somewhat different, with more schizophrenic spectrum vs. affective disorders than in the study sample (schizophrenia spectrum disorders: 24.8%, substance use disorders: 19.1%, and affective disorders: 18.3%).

About one-third of the sample (N = 131) had the index admission as their first psychiatric admission. In this group mean age was 36.8 (SD 15.8; range 18–83), 55.7% were men, and the median duration of stay was eight days (range 1–38). The most prevalent primary diagnoses were affective disorders (42.7%), substance use disorders (20.6%), neurotic, stress-related, and somatoform disorders (13%).

3.1. Suicide risk ratings

Upon admission, 86 (22.6%) of the patients were assessed with high suicide risk, and 254 (66.8%) patients were evaluated as low risk (missing=40 (10.5%)).

3.2. Suicide-mortality in the cohort

Eleven (2.9%) patients died by suicide within three years after discharge, eight of whom were men. The mean age at death was 35 years (SD 11.6). Among the patients who died by suicide, one patient died within the first two months, another patient within the first six months, seven patients within the first two years, and two patients within three years.

3.3. Predictive validity of suicide risk categories

Eight of the high-risk patients died by suicide within three years of discharge, and three of the low-risk patients (OR 8.7, 95% CI: 2.2–33, *Pearson`s Chi-squared test* =0.002). Sensitivity and specificity were 73%/76%. Positive and negative predictive values (PPV/NPV) were 9.3%/99%.

3.4. Logistic regression analyses

In the bivariate analyses, recent SI, affective disturbance, disturbance in arousal, and recent insomnia were associated with the overall evaluation of high suicide risk (i.e., not actual suicide) (Table 2). Lifetime suicide attempts and low age were also associated with high suicide risk.

Further, we did multivariable analyses with the variables significantly associated with ($p<0.05$) high suicide risk.

Among the components of the suicide risk assessment, we found that recent SI (OR 3.2, 95% CI: 1.2–8.9, p = 0.023) and affective disturbance (OR 5.4, 95% CI: 1.4–21.7, p = 0.017) had significant independent associations with high suicide risk. This analysis included 152 patients (40%) (Table 3).

In the second multivariable analysis, including recent SI, affective disturbance, disturbance in arousal, and recent insomnia (see Methods 2.5), we found that recent SI (OR 3.6, 95% CI 1.5–8.7, p = 0.004), and affective disturbance (component of SCS) (OR 4.3, 95%CI: 1.5–12.6, p = 0.008) had a significant independent association with high suicide risk (i.e., not actual suicide) during the three years follow-up period after discharge. Insomnia (recent) (component of SCS) (OR 2.6, 95% CI: 0.99–6.9, p = 0.052) trended towards significance. This analysis included 202 patients (53%).

4. Discussion

We found that the overall suicide risk assessment based on a modified measure at intake to an acute psychiatric department was a powerful predictor of suicide post-discharge. Despite the low base rate for suicide deaths, patients rated at high risk at admission were almost nine times more likely to die by suicide in the ensuing three years than those rated low risk. Sensitivity and specificity were solid, and the negative predictive value was high. Nonetheless, the positive predictive value was low, as related to the low base rate. The suicide risk assessment consisted of different elements, incorporating a total of 18 variables. We wanted to explore which of the different components of the suicide risk assessment done during index admission were related to high suicide risk. In bivariate analyses, we found that recent SI, affective disturbance, recent insomnia, suicide attempt lifetime, and low age were associated with high suicide risk (i.e., not actual suicide) after discharge.

In multivariable logistic regression analyses, we found that recent SI and affective disturbance were independently predictive of high suicide risk (i.e., not actual suicide). Insomnia trended towards significance.

There have been many struggles to find a way to predict suicide. The American Psychiatric Association pointed out in their guidelines from 2004: “The rarity of suicide, even in groups known to be at higher risk than the general population, contributes to the impossibility of predicting suicide” (American Psychiatric Association, 2004). This has been the accepted wisdom in psychiatry for a long time. Most work on suicide risk assessment has focused on chronic traits and risk factors. A large number of established risk factors for attempted suicide and completed suicide have been identified, including male gender, age, psychiatric diagnosis, substance abuse, impulsivity, high levels of hopelessness, a family history of psychiatric disorders or past suicide attempts, and others (Deisenhammer et al., 2006; Hunt et al., 2007; Kessler et al., 1999; Madsen et al., 2012, 2017). However, it is considered very challenging to predict suicide both in the short and long term based on these known risk factors. One problem is that scales known to measure risk factors for suicide can give a high number of false positives (Cassells et al., 2005; Hendin et al., 2010; Pokorny, 1983). For a risk factor to be clinically useful, it should be able to affect how we manage an individual patient. In other words, the risk factors should help us to find patients with imminent risk, and they should be amenable to treatment (Goodwin, 2003).

Contrary to what Large and colleagues (Large et al., 2011a) pointed

Table 3
Multivariable logistic regression on variables significantly associated with ($p<0.05$) high suicide risk in univariate analysis. *(N = 152)*.

	OR	95% CI	P-value
Suicide thoughts recent	3.24	1.18–8.92	0.023
Disturbance in arousal	1.18	0.32–4.36	0.801
Affective disturbance	5.42	1.36–21.65	0.017
Insomnia recent	1.83	0.61–5.45	0.279
Age	0.99	0.97–1.02	0.597
Suicide attempts lifetime	1.12	0.91–1.37	0.279

OR odds ratio, CI confidence interval.
Notes: Logistic regression analysis with suicide risk assessment as outcome variable.

Table 4
Multivariable logistic regression on variables significantly associated with high suicide risk in univariate analysis($N = 202$).

	OR	95% CI	P-value
Suicide thoughts recent	3.6	1.5–8.72	0.004
Disturbance in arousal	1.67	0.63–4.4	0.304
Affective disturbance	4.3	1.48–12.6	0.008
Insomnia recent	2.6	0.99–6.9	0.052

OR odds ratio, CI confidence interval.
Notes: Logistic regression analysis with suicide risk assessment as outcome variable.

out in their meta-analysis, we found a value in suicide risk categorization into low or high suicide risk levels to identify patients at high suicide risk. One explanation might be that we prospectively examined post-discharge suicide rates among patients categorized as high or low risk during hospital admission. However, the small sample size could also bias the results, such that replication with larger samples is indicated.

Fawcett and colleagues did uncover robust risk factors for suicide, namely anxiety and panic, insomnia, severe anhedonia, and recent alcohol abuse (Fawcett et al., 1990). Further, they found high suicide risk in the first year after discharge (Fawcett et al., 1987). These crucial findings have influenced further research on this topic. Galynker and colleagues have developed a suicide risk construct, the Suicidal Crisis Syndrome, based on cognitive and affective dysregulation. This includes elements such as extreme anxiety, mood swings, anhedonia, ruminative flooding, agitation, global insomnia, and entrapment (Galynker, 2017).

Our findings correspond with previous studies focusing on the current state of the patients and warning signs more than chronic risk factors (Fawcett et al., 1990; Rudd et al., 2006; Schuck et al., 2019; Yaseen et al., 2019). In the present study, affective disturbance and insomnia, which are parts of the SCS (Galynker, 2017), were associated with high suicide risk. Crucially, the present study is, to our knowledge, the first to find this association with completed suicides and not solely to suicidal behavior. Such state factors may distinguish patients in an acute suicidal state, making it possible for clinicians to do lifesaving interventions in the high-risk group.

Recent SI was also associated with high suicide risk. This agrees with several studies that have found an association between SI and suicide post-discharge (Chung et al., 2017; Fosse et al., 2017; Large et al., 2011a, 2011b). SI is not required for diagnosis in the SCS, though it may be present, and symptoms of the SCS have shown an association with both recent suicidal thoughts and behaviors (Calati et al., 2020).

Our findings support that suicide risk assessment at admission to psychiatric and emergency services can be conducted in a clinically meaningful manner, identifying patients with high suicide risk. The present study is, to our knowledge, the first that prospectively examined suicide among patients that already have been categorized with high or low suicide risk. The suicide risk assessment in this study has different elements, including chronic risk factors and the assessment of warning signs. Fawcett et al. (1991) focused on the importance of distinguishing patients with an acute risk of suicide versus patients with chronic suicide risk (Fawcett et al., 1991). As such, a suicide risk assessment that includes both chronic and assessment of warning signs can be an essential contribution to the suicide research field and have clinical implications.

Immediate interventions are necessary for patients at imminent risk. Thus, these patients should be at the clinical focus in acute and emergency psychiatry. As resources in an acute ward are limited, differentiation between acute and chronic suicidal risk factors helps reduce the likelihood that chronic risk factors and other symptoms obscure the patients at imminent risk who require immediate interventions.

Treatment of anxiety, panic, and insomnia seem important for preventing suicide in this group. In an editorial summing up the results from two prospective studies, Goodwin (2003) focused on the importance of pharmacologic management of this state (Goodwin, 2003). Most of the patients in this group are voluntarily admitted and need to agree to treatment. The use of compulsory admission in this group might be a lifesaving intervention for some patients, but this could be too intrusive, considering the low positive predictive value of suicide risk categorization in the present study. Nonetheless, the presence of acute clinical risk factors, such as the SCS, indicates the need for intensified treatment, including hospitalization.

The strengths of this study are the prospective design, the catchment area-based, publicly funded health care system, and the national health registers in Norway, making it possible to assess the clinical history of all patients after discharge.

Our study population is small, which provides some methodological limitations in terms of generalizing the findings. The low participation rate could also limit the generalizability of our results. Specifically, schizophrenia was more common in the non-participation group and is associated with high suicide mortality, leading to a possible underestimation of suicide mortality. Other differences between those who did and did not participate in the study could also have affected our results. A substantial number of missing data on some variables assessing the components of the risk categorization can also have biased the results.

Patients categorized with high suicide risk as inpatients might also have received more care and treatment intervention that have prevented some suicides, which could indicate that our study underestimates the positive predictive value of suicide risk categorization (Large et al., 2011a).

In conclusion, the findings in this study indicate that assessment of suicide risk at admittance to an acute psychiatric department has value in finding patients with high suicide risk and therefore allowing lifesaving interventions. The component of the risk assessment that were significant predictors for evaluating high suicide risk was SI and affective disturbance; insomnia trended towards significance. Psychiatric services are in contact with a substantial number of suicide victims in the months preceding the act (Walby et al., 2018). Thus, it is vital to define the core high-risk population while there are still in the hospital. Implementing specific, preventive interventions targeting this high-risk population after discharge is crucial.

Data availability statement

The informed consent does not allow sharing of data other than to the collaborative researchers.

Disclaimer

Data from the Norwegian Cause of Death Registry, part of The Norwegian Institute of Public Health, has been used for this publication. The Norwegian Institute of Public Health is not responsible for the interpretations or analyses of the data.

CRediT authorship contribution statement

Astrid Prestmo: Visualization, Formal analysis, Methodology, Writing – original draft. **Karina Høyen:** Visualization, Methodology, Writing – original draft. **Arne Einar Vaaler:** Visualization, Funding acquisition, Methodology, Writing – original draft. **Terje Torgersen:** Visualization. **Tuva Prestmo Kvithyld:** Writing – original draft. **Lisa Janet Cohen:** Methodology. **Ole Kristian Drange:** Formal analysis, Methodology, Writing – original draft.

Declaration of Competing Interest

The authors of this paper have no conflicts of interest to declare.

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Appendix 1

Results from the workshop including all specialists in the Department to examine clinical terms used to describe the Clinical States Variables (Yaseen et al., 2019):

Disturbance in arousal:

- Restlessness
- High paranoia readiness (heightened/extreme paranoia)
- Hypervigilance
- Agitated
- Irritability
- Tense

Affective component:

- Suffering
- Desperation
- Internal pressure
- Anger
- Mental/emotional pain
- Extreme anxiety
- Acute anhedonia

Cognitive component:

- Psychomotor restlessness
- An overwhelming profusion of negative thoughts
- Racing thoughts (avalanche of thoughts)
- Suppression of thoughts
- Rumination
- Repetitive
- Irrational
- Fragmented
- Mental tension
- Confused
- Mentally restless
- Cognitive overload
- Cognitive rigidity/ rigidity

Entrapment:

- Unbearable situation
- The feeling of being trapped
- Hopelessness/despondent
- Extreme desperation
- Inability to escape an intolerable situation.

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