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Risk Factors for Suicide Attempt During Outpatient Care in Adolescents With Severe and Complex Depression

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Abstract: *Background:* Young people receiving tertiary mental health care are at elevated risk for suicidal behavior, and understanding which individuals are at increased risk during care is important for treatment and suicide prevention. *Aim:* We aimed to retrospectively identify risk factors for attempted suicide during outpatient care and predict which young people did or did not attempt during care. *Method:* Penalized logistic regression analysis was performed in a small high-risk sample of 84 young people receiving care at Orygen's Youth Mood Clinic (age: 14–25 years, 51% female) to predict suicide attempt during care (N = 16). *Results:* Prediction of suicide attempt during care was only moderately accurate (Area Under the Receiver Operating Curve range 0.71; sensitivity 0.57) using a combination of sociodemographic, psychosocial, and clinical variables. The features that best discriminated both groups included suicidal ideation during care, history of suicide attempt prior to care, changes in appetite reported on the PHQ-9, history of parental separation, and parental mental illness. *Limitation:* Replication of findings in an independent validation sample is needed. *Conclusion:* While prediction of suicide attempt during care was only moderately successful, we were able to identify individual risk factors for suicidal behavior during care in a high-risk sample.

Keywords: suicide, adolescents, risk factors, treatment, suicidal behavior

Death by suicide in young people is an important global concern. Suicide is the second leading cause of death in young people between age 15 and 29 years (WHO 2021). Despite national and international prevention efforts, the number of young people who experience suicidal thoughts and behaviors (STBs) has continued to increase. In the United States, the suicide rate among young people between age 10 and 24 years increased by almost 60% between 2007 and 2018 (Curtin 2020). This is mirrored by an increase in suicide attempts in high school students between 2009 and 2019 (Ivey-Stephenson et al., 2020). In Australia, suicide rates have also risen among young people (age 18–24 years); they increased by almost 50% between 2010 and 2019 (Australian Institute of Health and Welfare, 2020).

Evidence shows that people in mental health care are at elevated risk for suicidal behavior and that between 25% and 50% of individuals who die by suicide have had contact with mental health care services before their death (Stene-Larsen and Reneflot 2019). The majority (80%) of young people who die by suicide have visited a health care setting weeks or months before their death (Ahmedani et al., 2014; Farand et al., 2004; Rhodes et al., 2013). Suicide risk assessment by clinicians therefore represents a critical aspect of suicide prevention. Increasing our understanding of risk factors for suicidal behavior during care is vital for suicide prevention. Various risk factors for suicidal behavior in young people have been identified, including youth and parental mental illness, parental separation, parental suicide and low socioeconomic status (SES), violence, child abuse, and neglect (Agerbo et al., 2002; Christoffersen et al., 2003). To our knowledge, no studies have examined risk factors for suicide attempt during outpatient mental health care in young people.

The aim of this study is therefore to use a multivariate approach to identify sociodemographic, psychosocial, and

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clinical risk factors for suicidal behavior during an episode of care in young people treated between 2015 and 2018 at Orygen's Youth Mood Clinic (YMC), a state government-funded youth mental health service in Melbourne, Australia. The YMC focuses on early intervention for severe and complex depression providing multidisciplinary, team-based outpatient care for young people between age 15 and 25 years (Rice et al., 2017, 2021). Using an established machine learning approach, we evaluated the utility of different demographic, psychosocial, and clinical characteristics in predicting suicide attempt in a retrospective manner and identified the characteristics that offered the most predictive power. This is a study in a small, but unique, high-risk sample (of whom 20% attempted suicide during care) and will provide, for the first time, indications of which risk factors need to be monitored closely to potentially prevent a suicide attempt during care.

Materials and Methods

Sample

Participants included 84 young people between age 14 and 25 years (M_{age} = 19.2, SD = 3.0; 51.2% female) engaged in treatment at Orygen's YMC. The median duration of an episode of care at YMC was 160 days in this sample. All participants were at moderate-to-high risk for harming themselves or had poor psychosocial functioning.

A total of 89.3% were diagnosed with at least one depressive disorder (89.2% major depressive disorder, 3.6% bipolar disorder, 1.2% dysthymia), and 32.1% were diagnosed with one or more anxiety disorders (10.7% social anxiety disorder, 8.3% post-traumatic stress disorder, 7.1% generalized anxiety disorder, 3.6% obsessive-compulsive disorder, 3.6% panic disorder, 2.4% other anxiety disorder). In addition, 16.7% had a substance use disorder, 10.7% had an autism spectrum disorder, 3.6% were diagnosed with attention-deficit/hyperactivity disorder, 3.6% met criteria for an eating disorder, 2.4% had body dysmorphic disorder, 1.2% met criteria for borderline personality disorder, 1.2% had conduct disorder, and 1.2% had oppositional defiant disorder. Comorbidity in this sample was common, with 46% of participants experiencing a comorbid disorder. The most frequent combination of comorbid disorders was a comorbid depressive disorder and anxiety disorder (29.8%).

This project was approved by the Melbourne Health Human Research Ethics Committee (reference number QA2019066).

Variables

All data were extracted from the participants' medical records (including the clinicians' notes recorded during the participants' episode of care).

Outcome Variable

The outcome variable was a dichotomous variable that represents suicide attempt during an episode of care at YMC (coded: yes/no upon mention of suicide attempt with potentially fatal consequences accompanied by a reported intent to die).

Predictor Variables

Sociodemographic, psychosocial, and clinical variables at the time of YMC admission were included as predictors of suicide attempt during care and are described below (for a complete overview of all included measures, see Table E1 and Table E2 in Electronic Supplementary Material 1 [ESM 1]). These variables were selected based on their association with suicidal behavior in previous studies (Franklin et al., 2017; Large et al., 2011; Huang et al., 2017, 2018).

Sociodemographic Variables

The following variables were included as sociodemographic predictors: age at YMC entry, gender, relationship status, birth in Australia, employment status, highest level of education, and type of accommodation at YMC entry.

Psychosocial Variables

Lifetime history of parental separation, exposure to domestic violence, loss of a family member or close friend, sexual abuse, physical abuse, migration, and bullying were included as psychosocial variables. Self-reported conflict with a romantic partner, social isolation, and family conflict/problematic relationships were also included.

Clinical Variables

Treatment-related variables included the number of face-to-face contacts between the client and the case manager, the number of face-to-face contacts between the client and the consultant, the pattern of client disengagement (e.g., not answering calls or attending appointments), and the duration of treatment at YMC (in days). Maternal and paternal family history of mental illness (reported by the young person) were also included as clinical predictors. The following suicide-related variables were included: lifetime history of self-harm, self-harm at YMC entry, suicide attempt prior to YMC entry (yes or no), the number

of previous suicide attempts, suicidal ideation during the episode of care with YMC, suicidal ideation precipitating the referral to YMC, and suicide attempt precipitating the referral to YMC. Suicide attempt was defined as "behavior with potentially fatal consequences accompanied by a reported intent to die," and was used to ensure self-harm was differentiated from suicide attempt (Nock et al., 2014). Self-harm was defined as "physically self-injurious behavior performed without a reported attempt to die," in line with previous work (Van Orden et al., 2010).

Finally, the severity of psychotic symptoms at entry to the YMC on the Prodromal Questionnaire (PQ-16 total score; Ising et al., 2012) and nine individual item scores on the Patient Health Questionnaire (PHQ-9; Kroenke et al., 2001) were included as additional predictors.

Statistical Analysis

The participants were divided into two groups: (1) no suicide attempt during episode of care ($n = 68$) and (2) suicide attempt during episode of care ($n = 16$). Penalized logistic regression, a robust, established machine learning method that has been applied to similar problems in the past (Dinga et al., 2018), was used to predict suicide attempt during the episode of care. The glmnet package in R was used to build the penalized logistic regression model, and to assess generalizability, five-fold cross-validation was performed (Friedman, Hastie, & Tibshirani, 2010). A detailed description of the machine learning analysis can be found in ESM 1. Performance of the model was assessed using the area under the receiver operating curve (AUROC), sensitivity, specificity, and balanced accuracy (see ESM 1 for a description of these measures). To identify the variables that contributed most to the predictive model, the features that had a coefficient more than 0 in at least 85% of the 100 models were selected.

Secondary Analysis

The type of psychiatric diagnosis was not included as a feature in the main analysis as the young people receiving treatment through YMC show complex depression, with a main feature of this being comorbidity, with corresponding difficulty determining primary diagnosis. To test if the type of psychiatric diagnosis contributed to the model to predict suicide attempt during care, the same method was repeated with additional diagnosis variables (Table E3 in ESM 1).

Results

The results of the classification are presented in Table 1. The AUROC value was 0.71. The sensitivity of the model was 0.57 while the specificity was 0.67.

The features that most contributed to the prediction of suicide attempt during care were the following: suicidal ideation during episode of care with YMC, suicide attempt before YMC admission, the appetite disturbance item from the PHQ-9, history of parental separation and maternal, and paternal history of mental illness (see Figure 1). The results of analyses with different alpha levels are presented in Table E4 in ESM 1.

Secondary Analysis

Inclusion of diagnosis variables to the model did not affect the AUROC (0.70), and the diagnostic variables were not selected as most contributing variables to the model (Table E5 in ESM 1).

Discussion

In this study, we used a combination of sociodemographic, psychosocial, and clinical variables to predict a suicide attempt during outpatient care in a high-risk sample of young people. Using penalized logistic regression analysis, we were moderately successful at predicting suicide attempt (AUROC 0.71). In addition, the sensitivity of our model was also modest. High sensitivity of suicide risk assessments (i.e., the ability to predict suicidal behavior if it is actually present) is crucial given the seriousness of the outcome. The sensitivity of our model was below the sensitivity of already existing suicide assessment tools in predicting suicidal behavior 6 months later (Madan et al., 2016). The AUROC measures were also lower than findings from a previous very large study (N = 30,000+ participants) that used clinical and sociodemographic variables, determined from electronic health records, to predict suicide attempt 2 years later in adolescents (AUROC 0.83–0.94; Walsh et al., 2018), and lower than a large study (N = 2,797) that used clinical, sociodemographic, and psychosocial variables to predict suicide attempts over 10 years in adolescents (AUROC: 0.82–0.83; Miché et al., 2020). Possible explanations for the lower performance

Table 1. Classification of suicide attempt during care: results of penalized logistic regression analysis

Alpha	AUROC	*SD* AUROC	Sensitivity	Specificity	Balanced accuracy
.25	0.705	0.140	0.566	0.665	0.615

Note. AUROC = area under the receiver operating characteristics curve.

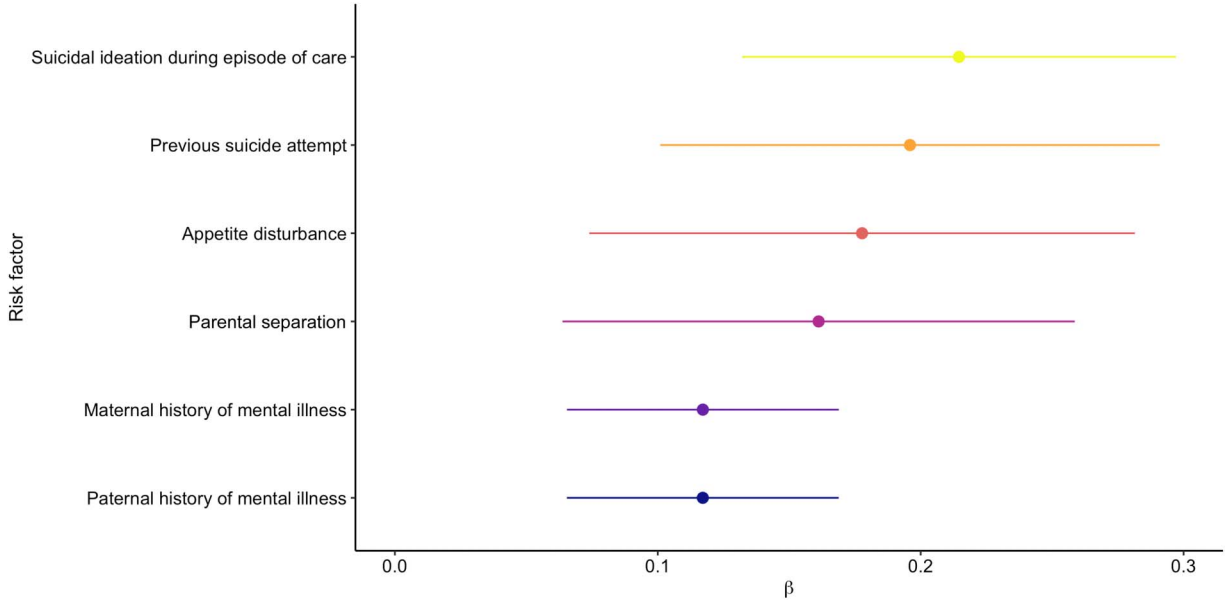

Figure 1. Coefficients of the features contributing to the prediction of suicide attempt during care.

measures in our study compared to these other studies may be that the follow-up period in our study is shorter and that both groups in our study have moderate-to-severe mental illness, which may have limited the discriminant ability between the suicide attempt and nonattempt groups, in comparison to studies on community samples (Miché et al., 2020). While our sample size was significantly smaller than these previous studies, our study included a unique sample of high-risk young people (of whom almost 20% attempted suicide during care), which allowed us to retrospectively predict suicide attempt during a short period of outpatient care, which is an important clinical question that may aid suicide prevention. Specific adjunctive interventions could be developed if those at risk for suicidal behavior during care can be accurately identified.

The moderate performance of the model to predict suicide attempt highlights the complex and multifactorial nature of suicide risk (Franklin et al., 2017) and adds to ongoing discussion on the feasibility of suicide prediction (Kessler et al., 2020). However, even when we acknowledge that suicide prediction is only moderately successful, risk stratification can still inform therapeutic interventions, as described by Wortzel et al., (2017), and while prediction is not perfect, identification of risk factors may reveal potential treatment targets and general mental health needs. In this study, suicidal ideation during care and a history of suicide attempt prior to YMC care were identified as risk factors for suicidal behavior during care. A history of STBs is one of the most common risk factors for future suicidal behavior and death (Hawton et al., 2013; O'Connor et al., 2015; Wenzel et al., 2011). In a meta-analysis of studies in adolescents and young adults, previous ideation was found to increase the odds of suicide attempt by 4.39 times in women and 3.97 in men, while previous suicidal behavior increased the odds of suicide attempt by 31.33 times in men and 6.97 times in women (Miranda-Mendizabal et al., 2019). However, suicidal thoughts have a dynamic nature and do not always lead to suicide attempt; therefore, it is extremely important to develop a better prediction model to monitor those at risk for suicide attempt. Due to the dynamic nature of suicidal ideation, a more time sensitive measure than ideation at each session of care might be needed (Rogers and Joiner 2019).

History of parental separation or divorce was also identified as a risk factor. These findings are consistent with previous work showing that parental divorce or separation may increase suicide risk in adolescents (Auersperg et al., 2019; Dieserud et al., 2010; Miché et al., 2020; Miranda-Mendizabal et al., 2019), potentially by increasing distress, severity of depressive thoughts, and development of an insecure attachment style (Auersperg et al., 2019). In addition, maternal and paternal family history of mental illness were found to be risk factors for suicidal behavior, again in line with previous work on risk factors for suicidal behavior in adolescents (Agerbo et al., 2002; Hawton et al., 2013; Miché et al., 2020). While these are known risk factors for suicide attempt, this study for the first time shows that these variables predict suicide attempt during outpatient care in young people. This study also adds to existing knowledge by showing that young

people who attempted suicide during care more often reported changes in appetite (poor appetite or overeating) in the past 2 weeks on the PHQ-9 at admission to treatment. Problems with appetite have been shown to increase risk for future suicide attempt in adolescents (odds ratio: 2.7) in earlier studies (Lewinsohn et al., 1994). Loss of appetite is a defining symptom of the melancholic subtype of depression (Beijers et al., 2019), which has been associated with increased risk of suicidal behavior in longitudinal studies (Lamers et al., 2016; Munoli et al., 2020). While we are unable to discriminate between loss of appetite and overeating as per the questions included in the questionnaire, we speculate that our association between appetite changes at baseline and suicide attempt during care may be driven by this subtype of depression.

While the modest classification performance does not allow clinicians to use a combination of these clinical, psychosocial, and sociodemographic variables to confidently predict which young person will engage in suicidal behavior during care, the results of this study do provide some direction for clinicians with regard to suicide prevention and risk assessment. First, our results further highlight the importance of continually monitoring suicidal ideation during every treatment session, specifically in young people who already have a history of suicide attempt. Second, clinicians could inquire about the young person's family history of mental illness and parental separation. Development of specific prevention programs to strengthen resilience and prevent STBs in young people with separated parents and those with a family history of mental illness may be warranted. Finally, research efforts need to continue to focus on the association between changes in appetite and suicidality.

In this study, we have examined risk factors for suicide attempt during care, which is important, as ideation-to-action studies have shown that not all variables related to suicidal ideation also increase risk for suicide attempt (for a review, see Bayliss et al., 2021). A strength of this study is the inclusion of young people with complex depression at high risk for suicide attempt, resulting in a relatively high number of suicide attempts during care in this study (almost 20% of the young people in this sample attempted suicide during care). In addition, to our knowledge, this is the first study to specifically examine risk factors for suicide attempt during specialized outpatient care in high-risk adolescents. However, our findings need to be interpreted with caution, as the sample size was limited, which in penalized regression may increase the uncertainty about the magnitude of penalization and thereby may decrease reliability of classification (Riley et al., 2020). In addition, future studies on this topic should include an independent validation data set, which we could not include here due to the limited sample size. In this study, the presence or absence of suicide attempt, suicidal ideation, and deliberate self-harm were determined from medical records. While we have used a strict definition for coding these variables, there may be inconsistencies on how these were coded across clinicians. Finally, it is worth noting that even if prediction of suicidal behavior improves in future studies, the clinical value of these predictive models still depends on the availability of effective preventative interventions to actually benefit those at risk (Kessler et al., 2020).

Conclusion

To conclude, using a combination of sociodemographic, psychosocial, and clinical variables, we were moderately successful in predicting suicide attempt in high-risk adolescents during outpatient care, and we were able to identify important risk factors for suicidal behavior during care.

Electronic Supplementary Material

The electronic supplementary material is available with the online version of the article at https://doi.org/10.1027/0227-5910/a000860

ESM 1. Detailed description of the analysis, overview of included variables used to predict suicide attempt during care, overview of sociodemographic, psychosocial, and clinical characteristics of the study, plus results of supplementary analyses

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