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Daily Prediction of Inpatient Suicide Attempts Using Routinely Collected Theory-Driven Data

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We lack knowledge about the short-term predictors of suicide attempts (SAs) among treatment-seeking individuals. The current study evaluated whether (a) interpersonal difficulties, hopelessness, and affective states are associated with an increased risk of SAs on the same and the next day; (b) these daily states are interconnected differently over time among inpatients who attempt suicide compared to those who do not. In total, 110 psychiatric inpatients who attempted suicide during their stay at a psychiatric hospital self-reported their suicidal ideation, negative affect, positive affect, wish to live, interpersonal needs, and hopelessness each day (3,018 daily reports). Multilevel structural equation modeling was used to examine same-day and next-day predictors of SAs. Multilevel temporal network models assessed interconnectedness between daily predictors and were compared to network models from a matched sample of 110 psychiatric inpatients who did not attempt suicide. In multivariate models, increases in perceived burdensomeness were significantly associated with same-day SAs, whereas increased hopelessness was associated with next-day SAs. Network models for patients who attempted suicide indicated that hopelessness and suicidal ideation were central to change, leading to next-day deteriorations in mental health. In subsequent models, feeling calm and relaxed, and feeling fresh and rested were centrally connected to other variables. The centrality of these metrics tended to be higher than in the network models for patients who did not attempt suicide, suggesting differences in the interplay between risk and protective factors. This study suggests routinely monitoring interpersonal factors and hopelessness may help identify increased short-term risk of SAs among psychiatric inpatients.

General Scientific Summary

Daily fluctuations in cognitive-affective states, such as interpersonal difficulties and hopelessness, may signal short-term risk for suicide attempts beyond reported levels of suicidal ideation. Hopelessness in particular exhibits high interconnectedness with other risk factors, potentially making it an effective target for interventions.

Keywords: interpersonal theory of suicide, wish to live, hopelessness, dynamic structural equation modeling, network modeling

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Michael J. Kyron served as lead for investigation, methodology, and

writing—original draft and served in a supporting role for funding acquisition. Geoff R. Hooke served as lead for data curation, project administration, resources, software, and supervision. Nikhila Udupa served as lead for writing—review and editing. Thomas Joiner served as lead for writing—review and editing. Andrew C. Page served as lead for conceptualization, funding acquisition, investigation, resources, supervision, and writing—review and editing and contributed equally to methodology. Michael J. Kyron and Geoff R. Hooke contributed equally to conceptualization. Craig J. Bryan, Glenn Kiekens, and Wai Chen contributed equally to writing—review and editing.

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Suicide is a leading public health issue worldwide, taking an estimated 800,000 lives per year (World Health Organization, 2018). Suicidal thoughts and behaviors are even more prevalent, with 9.2% of individuals experiencing suicidal thoughts and 2.7% attempting suicide at least once in their life (Nock et al., 2008). Yet, despite decades of dedicated research, rates of suicide have continued to rise in many nations or have remained stagnant (Australian Bureau of Statistics, 2021; Hedegaard et al., 2018). This disconnect may be impacted by a poor understanding of when an individual is at risk of suicide attempts (SAs; Kessler, 2019; Kiekens et al., 2021), curtailing opportunities for prevention when and where it is most needed. Research to date has largely been cross-sectional and of the relatively small number of longitudinal research studies, most have used observation windows from months to years (Franklin et al., 2017; Ribeiro et al., 2016) but without exploring critical periods when risks were heightened, and thus most acute. Such research has facilitated an understanding of who is developmentally at risk but are inadequate to determine when an incident may occur for a particular individual. Hence, a necessary step in preventing both behaviors is examining within-level processes that indicate when vulnerable individuals are at an increased risk for making a SA in daily life.

The period following discharge from psychiatric settings is associated with a heightened risk of suicide among inpatients. Identifying those most in need and providing timely support while in care and also providing community support postdischarge is therefore critical (Gunnell et al., 2012). The growing presence of routine psychological monitoring and feedback systems in inpatient psychiatric settings holds promise for measuring within-person dynamics that may provide warning signs for patients at risk of SAs (Kyron et al., 2019; Lambert & Harmon, 2018).

To better understand how to detect SAs over short-term periods and mitigate risk of suicide, research needs to evaluate with greater precision the theory-driven predictors of SAs in the hours and days before attempts occur. However, SAs are difficult to predict, and research is needed to identify both who is at an increased risk of attempting suicide and why it is more likely to occur on 1 day and not on another. Due to the low base rates of SAs (i.e., the vast majority of even high-risk individuals do not attempt suicide on a given day), few studies have been able to capture self-report data in the lead up to events. Daily prevalence rates are difficult to determine, particularly when factoring in contributing demographic, social, and clinical factors. For instance, one study followed 413 adolescents with a diagnosed Bipolar 1 disorder over time for five years, with 163 SAs identified over this period (Goldstein et al., 2012). Although a relatively large number of SAs, this reflects a daily rate of roughly 0.02%. Another review found that on average 1.4% of inpatients (both forensic and acute) attempt suicide during their stay (James et al., 2012), although with varied lengths of stay between studies it is difficult to ascertain average daily rates (e.g., a conservative average length of stay of seven days yields a daily rate of 0.2%). As such, few studies have been able to prospectively assess predictors of SAs using short-term repeated measures designs. For these reasons, clinical populations (especially a sample of hospitalized patients) would provide an optimal opportunity to capture the short-term variability in risk and protective factors before SAs occur and examine within-level processes associated with such attempts. Furthermore, recent technological advancements have facilitated the collection of data in daily life, such as daily diary studies and ecological momentary assessment, which capture variations

in key indices measured daily or multiple times daily, respectively (Myin-Germeys et al., 2018; Shiffman et al., 2008). Therefore, a study which applies these technical innovations to a psychiatric in-patient sample would provide a unique opportunity to evaluate key determinants of SAs with greater precision than previous studies. Moreover, these innovations can also facilitate interventions within clinical settings, with a recent shift toward personalized medicine through routine collection of data (Bos et al., 2019). The current study hence aimed to address this gap in the literature, while considering several theory-driven risk and protective factors that may be relevant to the short-term prediction of SA.

Suicidal Thoughts and SAs

Suicidal thoughts are an antecedent to lethal and nonlethal SAs that involve an active desire to attempt suicide. Furthermore, the intensity of suicidal thoughts predicts recent and future SAs (Kleiman et al., 2018; Ribeiro et al., 2016; Victor & Klonsky, 2014), particularly when ideation is sustained (Horwitz et al., 2015; Kleiman et al., 2018), although evidence from long-term longitudinal research (median follow-up 52 months) suggests this effect is weak (Ribeiro et al., 2016). However, SA are low prevalence behaviors, with few who currently report suicidal ideation engaging in SA (Kessler, 2019) and not every suicidal thought translates into action (or individuals who attempt suicide fail to report ideation). There are therefore inherent difficulties in prospectively collecting data for individuals who ultimately attempt suicide. Consequently, there is a dearth of literature dynamically assessing risk factors for SAs in daily life. It is therefore unclear the extent to which fluctuations in suicidal thoughts are associated with SAs. Further, it is unclear whether assessing a range of other risk and protective factors provides incremental benefits above assessing suicidal thoughts alone.

Interpersonal Predictors and SAs

Interpersonal factors are a critical component of theoretical models for suicide. The interpersonal theory of suicidal behavior (Joiner, 2007), the motivational volitional model of suicide (O'Connor, 2011; O'Connor & Kirtley, 2018), and the three-step theory (Klonsky & May, 2015) all propose similar interpersonal drivers of suicidality. For instance, the interpersonal theory (Joiner, 2005) proposed that two interpersonal states, perceived burdensomeness (i.e., feeling one is a burden to friends, family, and wider society, and that one's selfhood is a burden) and thwarted belongingness (i.e., not feeling supported by or connected to others), are central to the development of suicidal desire. Importantly, these are believed to be dynamic affective-laden factors that fluctuate over short time periods (Czyz et al., 2019; Kleiman et al., 2017). Intensive repeated measures studies have largely supported the roles of interpersonal factors in relation to suicidal thoughts in prospective research (Hallensleben et al., 2019; Kyron et al., 2018), and SAs in retrospective recall studies (Bagege et al., 2013, 2017). Thus, routine monitoring that includes interpersonal adversity may aid to predict SAs in psychiatric settings. To our knowledge, however, the prospective, daily associations between interpersonal factors and SAs have not been explored, and are essential in delineating the independent contributions of interpersonal factors in driving suicide risk beyond suicidal ideation (Klonsky & May, 2015).

Positive and Negative Affect and SA

Suicidality can be a response to complex negative affective experiences (Shneidman, 1993). Theories of suicide have also highlighted how entrapment (O'Connor, 2011) and pain (Klonsky & May, 2015) contribute to suicidal ideation, suggesting it may be associated with a broad spectrum of self-injurious behaviors. Two systematic reviews (predominantly of cross-sectional research) found negative affective states such as depression and anxiety to consistently be associated with a history of self-harm (Fliege et al., 2009; Moller et al., 2013); however, little research has examined associations with SAs. Further, the prospective temporal association between affect and SAs in daily life has received less attention, perhaps due to the low prevalence of behaviors. However, retrospective recall designs have identified increases in negative affect in the 6 hr immediately preceding a SA (Bagge et al., 2017). Further, shifts in affect have been linked to higher suicidal thoughts (Armeij et al., 2018; Ben-Zeev et al., 2012). Among psychiatric inpatients, preliminary evidence suggests that mean levels of negative affect assessed during inpatient visits are predictive of SAs postdischarge (Bentley et al., 2021). However, the dynamic association with positive affect and SA on a day-to-day basis, to the best of our knowledge, has not been examined and warrants consideration.

Wish to Live as a Potential Protective Factor Against Suicide

Decades of research has outlined an internal struggle between living and dying in suicidal individuals (Bryan, 2020). Wish to live can be conceptualized as a cognitive affective state that entails life-sustaining beliefs and thought processes such as optimism, hope, and purpose, as well as positive emotional states (Bryan, 2020). Research suggests that positive states like perspective taking, planning ahead, and the ability to identify and flexibly employ coping strategies in response to adversity and stressful life experiences, are all associated with a range of effects that should offset elevations in suicide risk. Clinical research has found that suicidal behaviors have a stronger association with a diminished wish to live rather than a heightened wish to die (Bryan et al., 2016). Further, recent research has found wish to live to be associated with lower rates of daily inpatient self-harm (conceptualized as both nonsuicidal self-injury and SAs), even when accounting for a concurrent wish to die (Goods et al., 2020; Kyron et al., 2020).

Hopelessness and SA

Beck's seminal research on suicide positioned hopelessness as a central aspect of the acutely suicidal individual (Beck, 1996). In preliminary longitudinal intensive research hopelessness has been linked to short-term increases in suicidal ideation among psychiatric inpatients (Hallensleben et al., 2019). However, some research has found that hopelessness only weakly predicts (Ribeiro et al., 2018) or fails to predict SAs (Qiu et al., 2017) in longer-term longitudinal research, while other research has found that individuals who attempt suicide exhibit heightened levels of hopelessness (Rodríguez et al., 2017). Studies examining the link between hopelessness and SAs over short-term periods (i.e., days, hours) have not occurred to our knowledge, and may provide further insight into this relationship.

Identifying Salient Targets for Treatment

A novel approach to examine how various factors are interconnected from day-to-day is multilevel vector-autoregressive network

analysis. This lends from conventional cross-sectional network analysis, multilevel modeling, and time-series analysis to comprehensively examine how various factors may influence each other from day-to-day. It effectively outlines which factors may be central to change among a variety of other factors (e.g., symptoms, risk/protective factors), with these methodologies typically conducted within clinical literature to identify potentially salient targets for treatment. The temporal nature of the vector-autoregressive form of network analyses allows for the identification of whether factors may possibly drive changes in other variables from one assessment to another or be impacted by other variables (as suggested by temporal precedence). Further, it provides a way to visualize how symptoms are interconnected from day-to-day, and therefore guide researchers and clinicians toward more complex and dynamic thinking about mental disorders (Bringmann & Eronen, 2018). The application of network analysis to patients who have engaged in SAs during acute periods has yet to occur to our knowledge and may provide important targets to reduce risk of specific forms of self-injury. Further, how networks differ between individuals who attempt suicide, and those who do not, may also guide decision making in clinical settings. That is, how do networks of risk and protective factors operate for patients who ultimately attempt suicide, and how do these networks compare to patients who do not? For instance, addressing whether interpersonal factors are a greater driver of overall symptom changes among people who attempt suicide compared to those who do not may help the deployment of interventions to patients at risk of taking their own life in the near future. It also helps understand the profile of patients who attempt suicide and how these characteristics differ from other psychiatric patients (i.e., is the interconnection between specific risk and protective factors exhibited by patients who attempt suicide typical for all patients?).

The Current Study

Due to the low prevalence of SAs, no studies to our knowledge have been able to prospectively examine daily associations with risk and protective factors of SAs. Thus, the current study looks to explore two research questions by examining temporal associations between variables of interest. Firstly, which theory-driven factors predict same-day and next-day SAs? To address this, the study will apply dynamic modeling to daily diary data to evaluate how the aforementioned risk (suicidal thoughts, interpersonal adversity, hopelessness, negative affect) and protective factors (positive affect, wish to live) are concurrently and prospectively associated with SAs. Secondly, the current study will identify which factors may be effective targets during treatment by conducting a network analysis of risk and protective factors for patients who attempted suicide during their stay to examine how they influence each other from 1 day to the next during acute periods of suicidality. These temporal within-level networks will be compared with patients who did not attempt suicide, which provides insights into how risk and protective factors interact differently from day-to-day between these two groups (e.g., are interpersonal factors more likely to influence negative emotional states among patients who attempt suicide?). As there are few studies examining short-term predictors of SAs the current study is largely exploratory, although it is expected that individuals with acute suicidal thoughts (and inversely, a low wish to live) will also be at risk of SAs. Further, as interpersonal difficulties are often reported in the lead-up to SAs in retrospective recall studies, it is expected they may be short-term predictors of attempts.

Method

Participants and Procedure

The current study was conducted as part of the ongoing assessment and treatment of inpatients at a 100-bed psychiatric hospital in Perth, Western Australia. Patients were presented with the opportunity to self-report their mental health on a daily basis as part of standard care through electronic tablet devices located in patients' rooms at a self-determined time. Typically, this occurred each morning (average 10:40 a.m., $SD = 3.5$ hr, $Q1 = 8:00$ a.m., $Mdn = 10:00$ a.m., $Q3 = 1:00$ p.m.) as this information is used in discussions with therapists. Admission to the hospital was voluntary, and a diagnosing clinician referred patients to receive specialized care tailored for a range of mental health conditions.

Information surrounding SAs were provided by clinical staff, who logged reports regarding each incident as part of risk management. Staff outlined the nature of the incident (i.e., self-injury that resembled an attempt to kill one's self, or self-injury without such intent), the time it occurred, the outcome (i.e., transferred to external medical hospital, minor intervention), and perceived intent (i.e., suicidal or nonsuicidal). All forms were completed in accordance with hospital policy and procedures were approved by the Chief Psychiatrist of Western Australia. Patients provided consent for the data to be used for research purposes at admission, and all procedures were approved by the University of Western Australia Human Research Ethics Committee (2021/ET000010). To improve reliability of coding, nursing staff were trained regarding how to recognize potential suicidal intent regarding self-injury, completed standardized daily suicide and self-harm risk assessment forms with patients, and noted discussions with patients and other contextual factors involved in their decision making. These entries were then reviewed during handovers with other nurses, and also with the psychiatrist overseeing each patient's treatment.

Measures

Thwarted Belongingness

Belongingness was measured by summing two items: "In the past day, I have felt that people care for me" and "In the past day I have felt close to others." Responses were reverse-scored so that higher scores indicated a greater sense of thwarted belongingness. Items were measured on a 7-point Likert-type scale (1 = *not true for me at all*, 7 = *very true for me*). Items were selected based on their strong factor loadings in clinical samples (Van Orden et al., 2012) and exhibited acceptable within-level reliability ($\omega = .73$).

Perceived Burdensomeness

Two items in total were used to measure perceived burdensomeness: "In the past day, I have felt like a burden," and "In the past day, I have felt like my death would be a relief to people." Items were measured on a 7-point Likert-type scale (1 = *not true for me at all*, 7 = *very true for me*). Item scores were combined, with higher scores representing higher perceived burden. Both thwarted belongingness and perceived burdensomeness items were adapted from the Interpersonal Needs Questionnaire (Van Orden et al., 2012), and had acceptable within-level reliability ($\omega = .76$).

Negative Affect

Negative affect was measured through four items that assessed depressed mood ("In the past day, I have felt depressed"), anxious mood ("In the past day, I have felt anxious"), worthlessness ("In the past day, I have felt worthless"), and feelings of not coping ("In the past day, I have felt that I am not coping"). All items were from the Psychological Distress Daily Index (DI-5; Dyer et al., 2014), and in the current study were defined as negative affect due to measuring potentially transient negative emotional states. All items were measured on a 6-point Likert scale (0 = *at no time*, 5 = *all the time*). The scale has shown strong psychometric properties (Dyer et al., 2014) and clinical validity (Dyer et al., 2016) overall. The negative affect items from the Psychological Distress Daily Index also exhibited acceptable within-level reliability ($\omega = .83$). Affect items were converted into total factor scores prior to modeling.

Suicidal Thoughts

Suicidal thoughts were measured through a single item ("In the past day, I've had thoughts of killing myself"), measured on a 6-point Likert scale (0 = *at no time*, 5 = *all the time*). This was taken from the Psychological Distress Daily Index (Dyer et al., 2014). Green et al. (2015) established the validity of a similar item predicting both deaths by suicide and SAs. Multiple studies report a test-retest reliability of such indices that is similar to the test-retest coefficients of clearly reliable and valid self-report suicide scales (i.e., the Depressive Symptom Index—Suicidality Subscale; Joiner et al., 2001; Metalsky & Joiner, 1997); regarding validity, the correlation between single-item suicidality indices and validated suicidality scales tends to be robust (e.g., $\geq .70$; Metalsky & Joiner, 1997). A similar state of affairs pertains in other domains (e.g., alcohol use; Smith et al., 2009).

Positive Affect

The WHO-5 Wellbeing Index (World Health Organization, 1998) is a self-report measure of positive mental health, including feeling fresh and rested, cheerful, in good spirits, active, and calm and relaxed. Each of the five items are assessed using a 6-point Likert-type scale (0 = *at no time*, 5 = *all the time*), with reference to the past day (e.g., in the past day, I have felt calm and relaxed). These items were combined into a positive affect factor score using confirmatory factor analysis, with higher scores indicating higher positive affect. The scale has exhibited high reliability and validity in prior inpatient clinical use (Newnham et al., 2010), and exhibited acceptable within-level reliability in the current sample ($\omega = .81$).

Identity-Based Hopelessness

A single item was taken from the Perceived Mastery Scale (Pearlin et al., 1981) to measure an aspect of hopelessness, "In the past day, I have felt there is no way I can change many of the important things in my life." It was measured on a 7-point Likert Scale (1 = *not true for me at all*, 7 = *very true for me*). Our points regarding single-item measurement are likely to apply here as well. This item exhibited good psychometric properties in prior research using both item response theory and confirmatory factor analysis approaches (Chen et al., 2013; Eklund et al., 2012; Lim et al., 2022). The wording of this item is consistent with conceptualization in other well-validated scales. Although hopelessness is a broader concept than

which can be captured through a single item, this item was chosen as it captures that one's own problems are unsolvable due to personal deficiencies, and this identity-based hopelessness is purported to be particularly salient among suicidal individuals (Rudd & Bryan, 2021).

Wish to Live

A single item was taken from the Scale for Suicide Ideation (Beck et al., 1979) to measure patients' wish to live, "In the past day, my wish to live has been..." measured on a 4-point Likert-type scale (0 = *none*, 1 = *weak*, 2 = *moderate*, 3 = *strong*). Here again, our points regarding single-item measurement are likely to apply.

Statistical Approach

Multilevel structural equation models (MSEMs) were fit to the data to examine same-day associations with SAs. An MSEM is useful in repeated measures designs for partitioning the within (i.e., variance occurring within an individual or relative to one's own mean) and between-level variance (i.e., variance across individuals occurring at an aggregate level or measuring individual differences). Models focusing on time-lagged associations (i.e., negative affect predicting next-day SAs) used a residual dynamic structural equation modeling (RDSEM) framework (Asparouhov et al., 2018). One important contribution of RDSEM models is the application to data that approximates a time series, including the estimation of two temporal relationships: (a) cross-lagged effects (e.g., the extent to which increases in feelings of hopelessness on 1 day are associated with increased probability of SAs on the next day) and (b) autoregressive effects (e.g., the extent to which increases in feelings of hopelessness on 1 day persist on the next day). Each model was specified using random intercepts with all other within-level parameters fixed. Both MSEMs and RDSEM used a Bayesian estimator, which allows computationally intensive modeling, and also provides accurate estimates for missing data (Asparouhov et al., 2018). Estimates are interpreted with their 95% credibility intervals, which give the range within which the "true" relationship is 95% likely to fall. For RDSEM models, Mplus uses a Kalman filter to account for missing data, which makes predictions of the next observation based on lagged predictors that are updated based on observed data (McNeish & Hamaker, 2020). There was found to be no significant correlation between mental health at admission, age, and percent of completed daily reported. There was weak correlation between (.152, $p = .023$) between sex and percent of completed reports, with females significantly more likely to complete surveys. All analyses were conducted using Mplus Version 8.2 Software (Muthén & Muthén, 2017). Time was included as a covariate in each model to take into account the treatment effects evident within the sample. Negative and positive affect items were first converted into factor scores through confirmatory factor analyses to take into account measurement error, and then entered into models.

Model Specifications

Within-level estimates have been standardized for each person separately, based on their individual variability in the outcome and covariate. These estimates are then averaged across individuals to ensure comparability. Adequate convergence of the model was evaluated through proportional scale reduction (PSR) criterion under 1.1 (Asparouhov & Muthén, 2010), which indicates that between-chain

variation is small relative to the within-chain variation (McNeish & Hamaker, 2020). In addition, trace plots were assessed for an absence of spikes and trends. A Bayesian estimator was used with 10,000 iterations and a thinning parameter of 10. In the current study all models exhibited stable PSR of less than 1.01, with trace plots showing no evidence of irregularities. The variance explained by each model is calculated in Mplus through a pseudo R^2 , which is calculated for the continuous latent response variables underlying the factor indicators. Guidelines regarding the minimum number of time points for RDSEM are varied; however, the current study has included patients with a minimum stay of 7 days in RDSEM analyses (i.e., minimum seven data points per person), and 10 days for the purpose of sensitivity analyses (Schultzberg & Muthén, 2018). All MSEM and RDSEM results presented in the current study are standardized, reflecting how many standard deviations the dependent variable increases, when the predictor variable increases one standard deviation. Missing data were imputed using default methods in Mplus (full information maximum likelihood in MSEM models; Kalman filter in RDSEM).

Modeled Variables

As new variables were introduced into routine monitoring at a later time point, separate models were developed using all historical data from 2009 onward ($N = 110$; 3,018 observations) and also from 2017 onward when items relating to interpersonal factors, hopelessness, and wish to die were introduced into daily monitoring ($n = 52$; 1,058 observations). For all 110 patients, data regarding suicidal ideation, negative affect, and positive affect were asked daily. For a more nuanced examination regarding which aspects of affect were predictive of SAs (e.g., feeling fresh and rested, anxiety, depression), supplementary univariate MSEM and RDSEM models were also fit to the data for each of the items from the WHO-5 and DI-5. That is, negative and positive affect represent broad constructs; however, insight into which components are most predictive of SAs may guide efficient, targeted interventions. Models were also run only with patients who completed 50% or over of their daily diaries to examine the impacts of missing data on regression estimates.

Treatment of Variables

In the current study, SAs were treated as a binary outcome (0 = *no suicide attempt on that day*, 1 = *suicide attempt occurred on that day*). Within MSEMs and RDSEM, a categorical dependent variable is handled using a probit link function. A positive probit regression coefficient suggests that the probability of a SA occurring is increased when the predictor value increases. A larger magnitude means that this probability increases faster. Coefficients have also been converted into predicted probabilities to aid further interpretation and presented in the online supplemental materials. Due to a degree of skew for the single-item Likert measure of hopelessness (i.e., most patients had higher levels of hopelessness) it has been treated as an ordered categorical variable in the analyses. In addition, as wish to live was composed of a 4-point Likert scale, and suicidal ideation a 6-point Likert scale, both were treated as categorical. Individual items from DI-5 and WHO-5 scales in regression models were also treated as categorical.

Network Plots

To assess the interconnectedness between independent variables in MSEM/RDSEM models, multilevel network models were fit to the

data for patients who attempted suicide ($N = 110$) and a matched sample of patients who did not attempt suicide ($N = 110$). This was conducted using the R package multi-level vector autoregression (mlVAR) (Epskamp, Waldorp, et al., 2018). This data-driven approach explores within-and-between person dynamics and allows for an intuitive examination of the interconnected, causal pathways between variables. Further, the mlVAR package explores autoregressive and bidirectional associations between variables at the within level. This provides a more comprehensive assessment of the associations between variables that may be obscured by traditional network models that do not provide distinctions regarding within-and-between level processes. Three types of network structures were estimated: within-level time-lagged or temporal, which examines how variables are interconnected from one day to the next; contemporaneous associations, representing how variables are associated within the same timeframe; and between-level, which examines how within-person mean levels of variables are associated on a larger time scale (e.g., how mean level of affect across participants relates to the mean level of suicidal ideation; Epskamp, Waldorp, et al., 2018).

The focus of network models is often the level of centrality of variables in the network, encapsulated by several statistics: closeness (i.e., the sum of the shortest paths between all nodes or how quickly a variable affects others in the network), betweenness (i.e., the number of times a variable is the shortest path or a bridge between other variables), and strength (i.e., the sum of all absolute edge weights a node is directly connected to). As the mlVAR network models feature bidirectional associations, metrics are computed to differentiate in-strength (i.e., the combined weights of associations directed toward a node or the extent to which a variable is directly affected by other variables) and out-strength (i.e., the combined weights of associations directed out of a node toward other nodes or the direct influence a variable has on other variables at the next assessment). The focus of comparisons between the networks of patients with and without SAs is the relative centrality of variables within the network, which have been converted into z-scores. A matched sample of 110 patients who did not attempt suicide were 1:1 propensity score matched based on age, gender, primary diagnosis, length of stay, and mental health at admission (as measured through the Depression Anxiety Stress Scale). The network model configuration applied to this sample was identical to that of patients who attempted suicide. Network models were compared in a relative sense using the aforementioned standardized centrality measures. Centrality scores over 0 in both models indicate a stronger influence of the variable within the network, whereas scores below 0 indicate a relatively weaker effect (Epskamp, Borsboom, & Fried, 2018). As with RDSEM models, an assumption of multilevel vector autoregressive models is that variables exhibit stationarity to provide reliable modeling estimates. Tests for stationarity have been presented in the online supplemental materials, with the majority of patient data meeting stationarity assumptions, as well as sensitivity analyses removing cases which violated stationarity tests. Various estimation methods can be applied within mlVAR; however, correlated contemporaneous and temporal effects were found to best suit the data. Comparisons of centrality metrics with fixed and orthogonal estimation have been presented in the online supplemental materials.

Modeled Variables

Several models were developed consistent with combinations used in MSEM/RDSEM models for both groups. The presentation

of mlVAR models within the main manuscript primarily focus on data including interpersonal, hopelessness, and wish to live items, in order to determine which broad factors may be interconnected from day-to-day ($n = 43$). However, models using individual items from the WHO-5 and DI-5 scales have been reported in detail within the online supplemental materials and discussed in-text ($n = 96$), while the models using total factor scores from these scales are shown in online supplemental materials only ($n = 96$).

Missing Data

Questionnaire completion rates at the hospital historically ranged from 55% to 77% of patients on a given day. The average percent of questionnaires completed per patient over an entire visit was 54.2% for patients who attempted suicide ($SD = 34.5\%$), and 64.7% for patients who did not attempt suicide ($SD = 34.3\%$). Overall, patients on average completed 16.85 daily questionnaires ($SD = 14.76$). There was found to be no statistically significant correlation between level of missing data and age ($r = -.01$, $p = .832$), nurse rated self-harm risk ($r = .08$, $p = .236$), general mental health ($r = .02$, $p = .766$) as measured by the Mental Health Questionnaire (MHQ-14), and depression ($r = .08$, $p = .236$), anxiety ($r = -.03$, $p = .707$), and stress ($r = .04$, $p = .587$) as measured by the Depression Anxiety and Stress Scale. There was small, but significant correlations between the level of missing data and gender ($r = .15$, $p = .023$), with females having slightly higher levels of missing data, and suicidal ideation at admission ($r = .17$, $p = .018$), with higher suicidal ideation associated with marginally higher levels of missing data.

Several approaches were trialed to impute missing data, such as multiple imputation, linear models and linear mixed-effects models, nearest neighbor, moving average, interpolation, random walk, smoothing, and a Kalman filter. To evaluate performance, 10% of completed questionnaire data points were randomly converted to missing and imputed figures were compared against actual scores. A Kalman filter approach was found to produce the lowest amount of error (based on mean absolute error and root-mean-square error). This approach uses observed values and the underlying dynamics of the time series to estimate the missing values, and iteratively updates its estimate based on the current measurement and the previous estimate. Imputation was conducted using the *imputeTS* package in R (Moritz & Bartz-Beielstein, 2017). For mlVAR models, results have been presented with missing data imputed. For RDSEM models in Mplus, a Kalman filter is the default method of imputation Mplus, while full information maximum likelihood is used in MSEM models.

Transparency and Openness

Data are not made publicly available due to agreements with the research hospital, although analysis code can be shared upon request. This study was not preregistered.

Results

Sample Characteristics

In total, 110 patients attempted suicide, with 124 SAs occurring in total (Table 1). The sample was predominantly female and not in a relationship at the time of admission. The historical average length of stay for the hospital is approximately 16 days, reflecting the

Table 1*Demographic Characteristic of the Total Sample (N = 110) and Data Available From 2017 Onward (N = 52)*

Demographic characteristic	Total sample N = 110		2017 onward sample N = 52	
	Frequency or M	Proportion or SD	Frequency or M	Proportion or SD
Sex				
Female	86	78.2%	34	72.3%
Male	24	21.8%	13	27.7%
Marital status				
Single	59	78.3%	32	68.1%
Widow/widower	—	—	—	—
Divorced	7	6.4%	2	4.3%
Separated	9	8.2%	3	6.4%
Married/defacto	35	31.8%	10	21.3%
Age	35.3 (min = 14, max = 77)	(SD = 15.8)	32.6 (min = 14, max = 77)	(SD = 15.2)
Average length of stay	24.9 days (min = 1 max = 78)	(SD = 19.0)	19.5 days (min = 1 max = 58)	(SD = 12.9)
Diagnosis (ICD-10 classification)				
Adult personality disorder	11	10.0%	6	12.8%
Mood affective disorders	65	59.1%	31	66.0%
Behavioral disorder	—	—	—	—
Behavioral/emotional disorder with childhood/adolescence onset	1	0.9%	—	—
Neurotic, stress-related disorders of psychological development	20	18.2%	4	8.5%
Other	1	0.91%	—	—
Schizophrenic	7	6.4%	2	4.3%
Substance disorder	5	4.5%	4	8.5%
Prior inpatient suicide attempts	14	15.6%	7	14.9%
Nurse rated self-harm risk (HONOS)—prior 2 weeks				
None	19	17.3%	6	12.8%
Fleeting	16	14.5%	7	14.9%
Low	18	16.4%	8	17.0%
Moderate	33	30.0%	13	27.7%
Serious	24	21.8%	13	27.7%
Average percent of self-reports completed	54.2% (min = 0% max = 100%)	34.54%	64.7% (min = 4.5% max = 100%)	34.3%

Note. ICD = International Classification of Diseases; HONOS = Health of the National Outcome Scale.

severity of the current sample with an average length of stay of 24.9 days. For patients who attempted suicide, 54.4% were transferred to an external medical facility and 29.8% required enhanced observation. The demographic characteristics of the matched sample are reported in Table S1 in the online supplemental materials. Patients who attempted suicide completed questionnaires on roughly 54% of days during their stay. Among patients who attempted suicide, the primary diagnosis was an affective disorder (59.1%), neurotic (18.2%), or personality disorder (10.0%). Correlations between predictors and average scores on each item/scale on the day of an attempt, the day prior, and every other day at the hospital have been reported in the online supplemental materials.

Concurrent Associations With SAs

Univariate associations between SAs and suicidal ideation, and negative and positive affect were first assessed for 110 patients (3,018 observations; Table 2). Increases in suicide ideation and negative affect were significantly associated with attempting suicide during the same day, accounting for 10% of variance in SAs. However, in the multivariate model only suicidal ideation remained significantly associated with SAs. When assessing individual items from the negative affect scale (DI-5) together in one model, higher-than-usual feelings of depression were significantly associated with SAs on the same day above and beyond

the effect of suicide ideation ($\beta = .18$, 95% credibility interval [CI] = [.02, .34]). No univariate associations for positive affect items (WHO-5) were statistically significant (Tables S4 and S5 in the online supplemental materials).

We subsequently evaluated whether interpersonal difficulties, hopelessness, and wish to live were associated with making a SA during the same day for the 52 patients who attempted suicide and completed assessments of these factors during their inpatient stay (1,058 observations). This revealed that suicidal ideation, perceived burdensomeness and hopelessness were concurrently associated with higher probability of SAs, while wish to live was negatively associated in univariate models. In a subsequent multivariate model only perceived burdensomeness remained a significant predictor. The pseudo R^2 statistic indicates that the predictors explained 16% of within-level variance in SAs. When running models only for patients that completed at least 50% of their daily diaries (80.7% average completing rate overall), there were no significant differences in models results, with burdensomeness remaining the only significant predictor ($\beta = .15$, 95% CI = [.01, .30]).

Time-Lagged Associations With SAs

Univariate associations between suicidal ideation, negative and positive affect, and next-day SAs were first assessed for 96 patients in the sample with over 7 days of daily data (2,932 observations;

Table 2

MSEM Univariate and Multivariate Probit Regression Models Assessing Standardized Within-Level Concurrent (Left Panel; $N = 110$) and Time-Lagged (Right Panel; $N = 96$) Predictors of Suicide Attempts

Predictors (T)	Same day suicide attempt (T)				Next-day suicide attempt (T + 1)			
	Univariate		Multivariate		Univariate		Multivariate	
	Std. estimate [95% CI]	SE	Std. estimate [95% CI]	SE	Std. estimate [95% CI]	SE	Std. estimate [95% CI]	SE
Suicidal ideation	.29 [.16, .40]*	.062	.30 [.13, .46]*	.092	.17 [.08, .27]*	.049	.17 [.08, .27]*	.049
Negative affect	.19 [.06, .33]*	.068	-.02 [-.20, .16]	.082	.07 [-.04, .18]	.056	—	—
Positive affect	-.04 [-.17, .09]	.066	—	—	-.07 [-.19, .06]	.066	—	—
	$R^2 = .10$				$R^2 = .06$			

Note. Variables with nonsignificant univariate associations with suicide attempts were not included in the final model. Statistically significant associations are boldfaced. Note that data for 14 patients were not included in residual dynamic structural equation modeling models due to an insufficient length of Model 4, leaving a total sample of 96 patients. Time (current length of stay) is included as a covariate in each model. MSEM = multilevel structural equation model; Std. = standardized.

* Statistically significant parameter, as indicated by the 95% credibility interval not including 0.

Table 2). Only suicidal ideation was significantly associated with SAs, accounting for 6% of variance in SAs. When assessing individual items from the negative (DI-5) and positive affect (WHO-5), only suicidal ideation exhibited a significant univariate association with SAs (see online supplemental materials). Further, this association remained when rerunning the model for patients with a length of stay of 10 or more days ($\varphi_{CL} = .25$, 95% CI = [.12, .37]).

Table 3 shows prospective results for 43 patients who attempted suicide and completed assessments of interpersonal difficulties, hopelessness, and wish to live during their inpatient stay (at least 7 days; 1,020 observations). Perceived burdensomeness and hopelessness were associated with a higher probability of SAs on the next day, while wish to live was associated with lower risk. In a subsequent multivariate model, only hopelessness remained a significant predictor for a SA on the next day. The pseudo R^2 statistic indicates that the predictors explained 15% of within-level variance in SAs. When running models only for patients that completed at least 50% of their daily diaries (81.6% average completing rate overall), there were no significant differences in models results, with hopelessness remaining the only significant predictor ($\varphi_{CL} = .27$, 95% CI = [.02, .58]). Further, this association remained when rerunning models for patients with a length of stay of 10 or more days ($\varphi_{CL} = .33$, 95% CI = [.02, .57]).

Connectedness Between Predictors

Multilevel network models were fit to the data to examine the interconnectedness between positive and negative affect scores, and suicidal ideation, interpersonal, hopelessness, and wish to live data for patients who attempted suicide (Figure 1A) and those who did not (Figure 1B). Additional models were also fit to the data using individual items from the DI-5 and WHO-5 scales, as well as total negative and positive affect scores.

For the model that was fit to data for patients who attempted suicide, suicidal ideation and hopelessness exhibited higher centrality relative to other variables among patients who attempted suicide ($n = 43$; Figure 2). Hopelessness exhibited high betweenness and closeness, while suicidal ideation exhibited high closeness. Both variables exhibited higher out-strength, which suggests they have a strong direct influence on other variables within the network. For instance, hopelessness predicted higher next-day suicidal ideation, burdensomeness, and negative affect. These were notably higher than in the network of patients who did not attempt suicide during their stay ($n = 43$). In addition, perceived burdensomeness exhibited relatively higher in-strength among patients who attempted suicide, indicating it is more susceptible to activation from other nodes amongst these individuals. Contemporaneous and between-level

Table 3

Univariate and Multivariate Probit Regression Models Assessing Standardized Within-Level Concurrent (Left Panel; $N = 52$) and Time-Lagged (Right Panel; $N = 43$) Predictors of Suicide Attempts

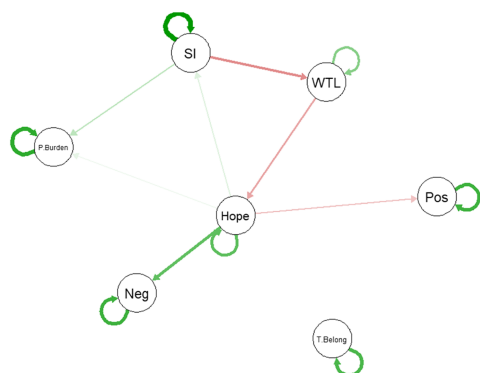
Predictors (T)	Same day suicide attempt (T)				Next-day suicide attempt (T + 1)			
	Univariate		Multivariate		Univariate		Multivariate	
	Std. estimate [95% CI]	SE	Std. estimate [95% CI]	SE	Std. estimate [95% CI]	SE	Std. estimate [95% CI]	SE
Suicidal ideation	.24 [.08, .40]*	.083	.07 [-.17, .31]	.123	.16 [-.04, .37]	.107	—	—
Negative affect	.11 [-.06, .28]	.087	—	—	.12 [-.06, .30]	.092	—	—
Positive affect	.02 [-.13, .18]	.069	—	—	-.13 [-.33, .06]	.101	—	—
Perceived burdensomeness	.34 [.18, .49]*	.079	.29 [.06, .48]*	.108	.24 [.07, .41]*	.086	.16 [-.07, .37]	.113
Thwarted belongingness	.17 [-.01, .32]	.084	—	—	.14 [-.06, .30]	.093	—	—
Hopelessness	.29 [.07, .48]*	.106	.08 [-.21, .36]	.147	.32 [.12, .50]*	.099	.29 [.00, .53]*	.136
Wish to live	.26 [.05, .45]*	.104	.05 [-.26, .30]	.145	-.25 [-.44, -.05]*	.101	-.05 [-.31, -.20]	.132
	$R^2 = .16$				$R^2 = .15$			

Note. Variables with nonsignificant associations with suicide attempts were not included in the final model. Significant associations are boldfaced. Note that data for nine patients were not included in residual dynamic structural equation modeling models due to an insufficient length of stay, leaving a total sample of 43 patients. Time (current length of stay) is included as a covariate in each model. Std. = standardized.

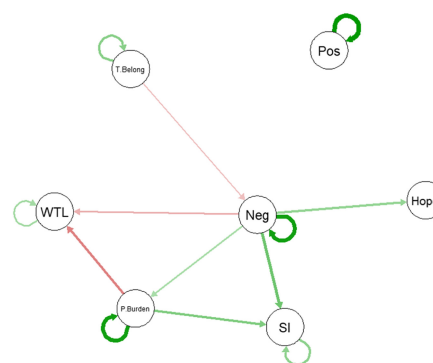
* Statistically significant parameter, as indicated by the 95% credibility interval not including 0.

Figure 1*m*IVAR Network Models for Patients Who Attempted Suicide, and Those That Did Not**Suicide Attempt Sample**

A) Within-Level Temporal

**No Suicide Attempt Sample**

B) Within-Level Temporal



Note. (A) Within-level temporal relationships between self-report items for patients who attempted suicide, including interpersonal items, hopelessness, and wish to live. Circled arrows represent autoregressive associations. Straight arrows indicate lagged associations between variables. (B) Within-level temporal relationships between self-report items for patients who did not attempt suicide. In both graphs, green (dark gray in print) arrows indicate positive relationships, while red (light gray in print) arrows suggest negative associations. *m*IVAR = multi-level vector autoregression; T.Belong = thwarted belongingness; SI = suicidal ideation; Hope = hopelessness; Neg = negative affect; Pos = positive affect; P.Burden = perceived burdensomeness; WTL = wish to live. See the online article for the color version of this figure.

results have been presented in Figure 3. Among patients who attempted suicide, wish to live was associated with lower same-day ideation, while negative affect was associated with higher same-day suicidal ideation. Affect was also interconnected with other cognitive-affective states, such as higher burdensomeness, hopelessness, and lower wish to live and positive affect.

Supplementary Models

For the model that fit individual items from the negative (DI-5) and positive affect scales (WHO-5) for the 96 patients who attempted suicide, feeling fresh and rested and feelings of anxiety exhibited high betweenness centrality, indicating they act as a critical bridge or mediator between other nodes in the network. For instance, feelings of anxiety were associated with a lower likelihood of feeling fresh and rested, which in turn tended to be associated with feeling interested and active on the next day. Feeling calm and relaxed exhibited higher closeness and out-strength relative to other variables in the network, and was associated with lower feelings of not coping and suicidal ideation from day-to-day. Feelings of anxiety exhibited relatively high in-strength, suggesting it tended to be influenced directly by other variables more than it influenced other variables. In the network of 96 patients who did not attempt suicide, depressed mood had notably higher betweenness and out-strength relative to the suicide sample.

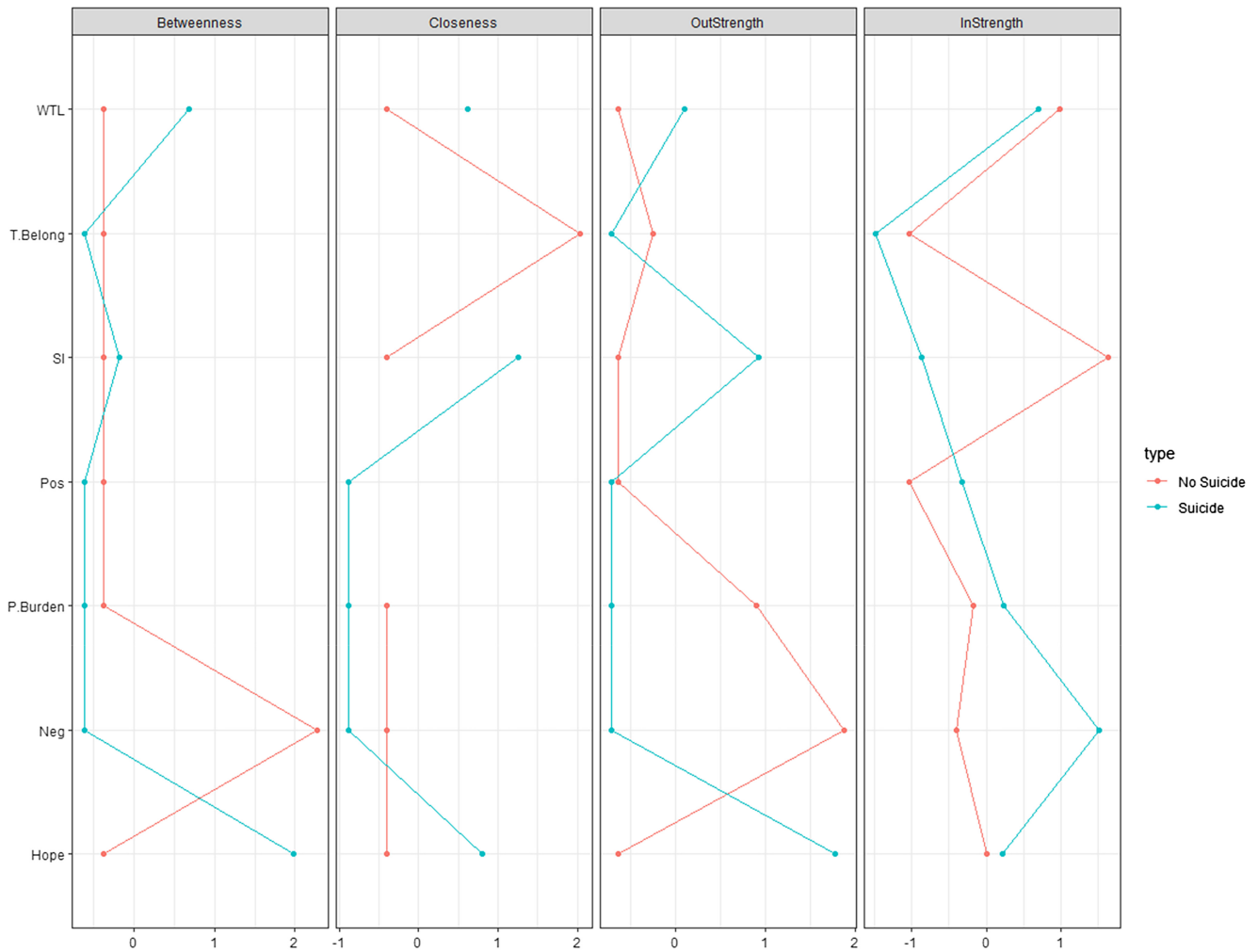
Discussion

To our knowledge the current study is the first to prospectively examine the daily within-person dynamics associated with SAs (Aim 1). The study found that deviations in perceived burdensomeness were associated with same-day and next-day SAs. This is consistent with prior evidence suggesting increases in perceived burdensomeness are associated with prior SAs in cross-sectional

studies (Brezo et al., 2006; Hill & Pettit, 2014), and negative interpersonal life events (specifically related to a romantic partner) tend to precede SAs in retrospective recall research designs (Bagge et al., 2013). In addition, we found that increased levels of hopelessness predicted increased risk for SA on the next day. Both factors may therefore be relevant risk factors to incorporate into dynamic predictive models for SAs. Although increases in wish to live and suicidal ideation exhibited significant univariate associations, they became nonsignificant in the final multivariate models.

Various theories of suicide, most notably the interpersonal theory of suicide (Joiner, 2005), posit that interpersonal problems, especially when combined with hopelessness that interpersonal problems will improve, are important drivers of short-term fluctuations in suicidal ideation, and other dispositional factors are largely responsible for the transition from thoughts to action (e.g., acquired capability). The current study finds that increases in perceived burdensomeness are predictive of SAs on the next-day beyond suicidal ideation, potentially suggesting that its effect on SAs is not simply due to increased suicidal thoughts; support for hopelessness emerged as well. However, there may be other plausible explanations. Certain individuals may not disclose their suicidal thoughts leading up to or on the day of an event, and other related variables may effectively capture suicidal intent. Alternatively, given the variability of suicidal ideation within a single-day, periods of diminished or heightened ideation may be missed through daily assessments, and predictive utility differs dependent on sampling densities (Coppersmith et al., 2023; Kleiman et al., 2017). Nursing staff may also have acted to prevent some incidents of suicide when suicidal ideation was reported by patients, which means the associated between ideation and SAs may be attenuated. Further, suicidal ideation may only represent part of a broader picture, whereby other suicidogenic factors are critical in capturing short-term risk of suicide (Bryan et al., 2022). In addition, certain potentially

Figure 2
Centrality Metrics for the Models That Included Interpersonal Items, Hopelessness, and Wish to Live (n = 43)



Note. SI = suicidal ideation; WTL = wish to live; Pos = positive affect; Neg = negative affect; Hope = hopelessness; P.Burden = perceived burdensomeness; T.Belong = thwarted belonging. See the online article for the color version of this figure.

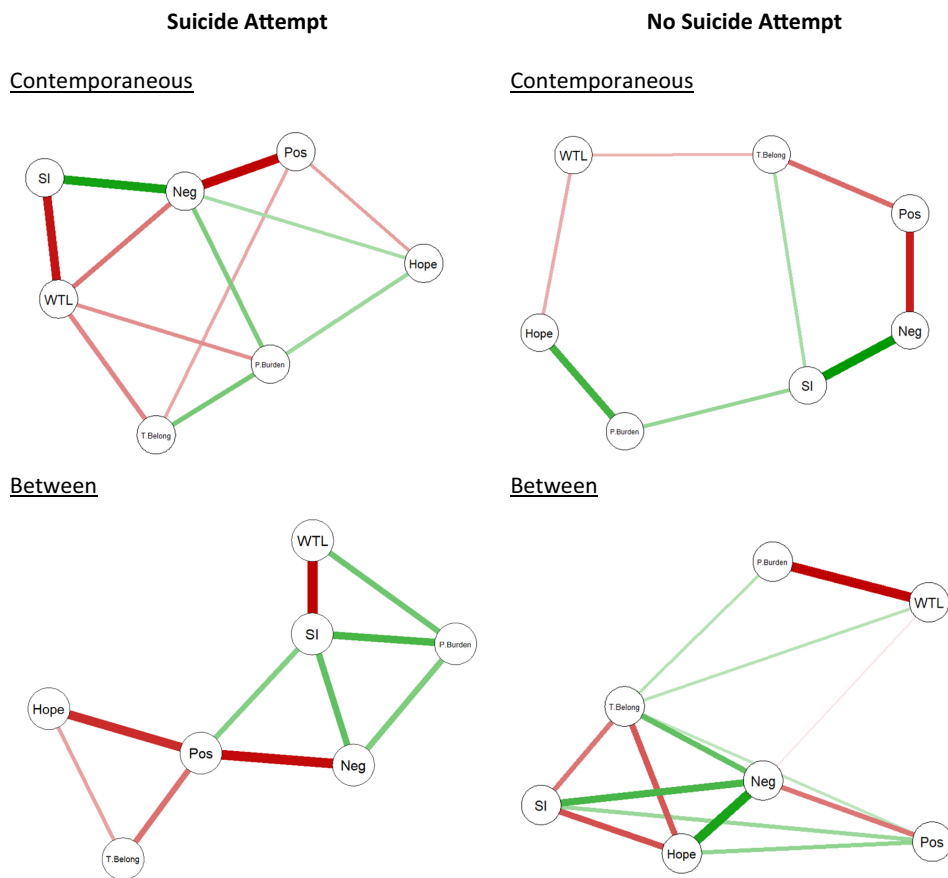
important aspects of suicidal ideation were not measured (e.g., intent, intent with specific plans), and may account for more variance in SAs. Regardless, among people with a history of SAs the daily fluctuation in interpersonal difficulties may signal short-term, high-risk periods for SAs that requires intervention.

Another important finding of the study was the identification of hopelessness and suicidal ideation as the most central variables in network analyses (Aim 2). This may point to the notion of a “suicide mode,” whereby cognitive, affective, and behavioral subsystems are activated in vulnerable individuals, and during a time-limited window may exacerbate maladaptive beliefs (Beck, 1996; Rudd, 2000). Further, the strong out-strength of hopelessness in the network supports the theoretical position that an acutely suicidal state is often characterized by a degree of hopelessness (Beck, 1996; Rudd, 2000). In other words, our findings provide preliminary evidence that “hopelessness” represents the central component of a “suicide mode.” Hopelessness in the current study in part captures that one’s own problems are unsolvable due to personal deficiencies, and reflects

perspectives that identity-based hopelessness is central to the suicide mode (Rudd, 2006; Rudd & Bryan, 2021).

Findings from the current study underscore the importance of routinely monitoring the thoughts and feelings of inpatients (beyond simply measuring suicidal ideation), which can inform clinicians’ interventions to prevent adverse events during hospital stays. The current study focused on evaluating how daily fluctuations from typical levels across all patients may be associated with SAs, and in practice could signal periods of heightened risk. A person-centered approach allows for identification of when particular risk and protective factors deviate from normal levels for a particular individual. When data are received on a daily basis, this information could be used to assist in identifying individuals at risk of self-harm, and also provide targets that can be integrated into therapy (Joiner et al., 2009). For instance, whether hopelessness, suicidal thoughts, and/or burdensomeness are elevated for an individual allows for specific feedback to clinicians. Future research may look to incorporate more intensive self-report assessments (i.e., multiple times daily) to examine more fine-grained

Figure 3
Contemporaneous Associations Indicate Same-Day Associations, While Between-Level Represent Associations Between Averages in Variables Across Patients



Note. T.Belong = thwarted belongingness; SI = suicidal ideation; Hope = hopelessness; Neg = negative affect; Pos = positive affect; P.Burden = perceived burdensomeness; WTL = wish to live. See the online article for the color version of this figure.

temporal relationships with SAs, including day and night effects, and to ensure high risk periods are captured. Further, other variables not measured in the current study may be important to account for more variance in SAs, such as entrapment, defeat, and unbearability (Bryan et al., 2022; O'Connor, 2011).

When examining specific aspects of positive and negative affect in network models, feeling fresh and rested, and calm and relaxed exhibited high centrality. These models were fit to data from a broader sample (i.e., all 110 patients) than the aforementioned results, which do not allow for direct comparison. Nonetheless, findings also suggest these parameters potentially represent key risk-reduction factors, malleable by targeted interventions. Feeling fresh and rested and anxiety exhibited higher in-strength than for patients who did not attempt suicide, suggesting that it was more likely to be affected by other risk and protective factors from day-to-day when compared with patients who did not attempt suicide, and are therefore more susceptible to activation among patients who attempt suicide. A key point from a clinical perspective is therefore directing resources toward factors which can be targeted with greatest efficiency; this may warrant mindfulness-based therapy and dialectical behavior therapy (Linehan et al., 1999) which

bolster feelings of coping and being calm and relaxed. Alternatively, sleep-based interventions, such as psychopharmacology and cognitive-behavior therapy for insomnia including sleep hygiene, may help patients to feel fresh and rested from day to day. However, if negative affective states diminish sleep quality, then such interventions may prove ineffective if the root cause of the disruption is not targeted. Our observational findings may embody important clinical implications, as treatments enhancing and promoting these factors can potentially be helpful; however, causal relationships can only be established by randomized intervention trials.

Predictive models based on routinely collected patient data may also aid timely decision making in clinical settings which are often limited by available resources. Incorrect treatment of at-risk patients can have significant costs, including those required to attend to patients (i.e., addressing wounds, increased observation, updating incident registers) and potential litigation. An important caveat to the current study's findings is that the performance of factors in the current study have not been evaluated in a real-world context among all patients (i.e., including patients who did not attempt suicide) and in different psychiatric settings. Among patients who attempted suicide

only 15% of within-person variance was accounted for, indicating that a number of other unmeasured or unmeasurable factors may influence suicidal behaviors from day-to-day, including such factors as opportunity to attempt, which may be somewhat limited in settings like the current one, and which can be challenging to operationalize. Further, the impacts of risk and protective factors may not always be heterogeneous, and development of personalized models (e.g., group iterative multiple model estimation; see Kaurin et al., 2022) may be a logical progression of research aiming to leverage the power of routinely collected patient data.

It is important to note that the current study consisted of a select sample of 110 patients who had attempted suicide throughout their stay out of a significantly larger sample of patients who did not attempt suicide. This approach provides an indication of when an individual is likely to attempt suicide, rather than simply who is at-risk like prior research. As the vast majority of patients do not attempt suicide, predicting SAs using a limited set of daily predictors will likely result in a large number of false positives. That is, many patients will experience fluctuations in burdensomeness and affect, but for only a limited number of patients will this result in a SA. In practice, prediction of SAs requires an understanding of both the who and when to produce accurate models with low false-positive rates (Kessler, 2019). Prediction of suicide to date has suffered from overinclusive predictive models that suggest an individual will self-injure, when no such attempt actually occurs (Large & Ryan, 2014). This may lead to inefficiencies in the allocation of clinical resources, which may result in a failure to prevent SAs or result in the containment of individuals at low risk. A two-step approach may be beneficial: firstly, identifying trait-like predictors that capture a high proportion of individuals likely to attempt suicide at some point, such as prior self-harm and low distress tolerance; secondly, monitoring dynamic state-like factors that may indicate imminent high-risk periods, as is done in the current study. This approach has been outlined in the fluid vulnerability theory of suicide (Bryan & Rudd, 2016; Rudd, 2006), which assumes that there are nonlinear dynamics between trait and state risk/protective factors for suicide. For instance, recent research has found that clinical inpatients with lower distress tolerance were more likely to experience suicidal thoughts on days when experiencing interpersonal adversity (Kyron et al., 2022). The current study provides an indication of factors that act as state-like risk factors for suicide that can be integrated in future research assessing interactions with distal or trait-like risk factors.

Limitations and Directions for Future Research

The current study has several important limitations that provide pathways for future research. Firstly, the sample was predominantly female, which likely reflects the relatively higher proportion of females with mood disorders and hence the numbers referred to the hospital for therapy, limiting generalizability to wider (nonclinical) populations. Second, due to the low prevalence of SAs (124 attempts across 110 patients), we observed large credibility intervals around estimates. Therefore, the present findings should be considered preliminary, with future work with larger samples required to replicate these findings. To our knowledge, however, the current study is the first to examine daily associations with SAs and provides an important indication of short-term risk factors. Third, the findings from the current study should be interpreted within an inpatient context, and may not necessarily reflect circumstances in an outpatient context. Relatedly, it is unclear the extent to which suicidal ideation

may be used instrumentally by patients to avoid or receive desired clinical contact. Further, safety protocols within a clinical environment may have prevented SAs despite increases in risk factors and reductions in protective factors, thus potentially attenuating effects identified in the current study. Similar research should be conducted with other non-inpatient samples to confirm these findings. Fourth, nursing staff may have incorrectly coded SAs as nonsuicidal self-injury, or vice versa. Although it is not possible to determine whether such classification errors were made, several practices are in place at the hospital to mitigate the likelihood of these errors (e.g., training, daily suicide risk assessment forms, discussions with the patient, other nurses and psychiatrists following self-injury). Fifth, due to the limited number of patients who attempted suicide, it was not feasible to conduct analyses by sex and different age groups. However, the associations between risk and protective factors and SAs may differ between groups and should be explored in future research. Lastly, single-item measures were used for several constructs, including hopelessness, wish to live, and suicidal ideation. These variables are multifaceted, and particular components were prioritized based on theory and prior research. This includes a focus on active, rather than passive suicidal ideation (Joiner et al., 2009), and a focus on identity-based hopelessness consistent with Rudd and Bryan (2021). For example, other aspects of suicidal ideation, such as intent, method, and plan, may be important aspects differentiating who will attempt suicide on particular days. Relatedly, four items were used to develop a “negative affect” score, a short-hand label which was used to be consistent with Kyron et al. (2023) and conceptually were defined to reflect potentially transient emotional states. However, these particular items (i.e., worthlessness) may also encapsulate broader aspects of psychological distress, particularly if persistent, and therefore results should be interpreted with this in mind. Further, specific items also captured aspects of daily life that may operate differently within an inpatient setting (e.g., I have felt supported, I have felt close to others), given the more restricted contact outside of the hospital. Although results should be interpreted within the context of an inpatient setting, patients were still allowed visits and calls to family or friends, and these items still exhibited high variability from day-to-day. Results should therefore be interpreted with these limitations in mind, as the brevity required for daily assessments within psychiatric care limit the ability to explore a wider range of constructs and also multiple components of specific constructs. It is also important to note that the length of stay of the current sample differs from those that may be evident within other settings globally, with differences noted between public and private psychiatric settings, and across countries. For instance, the maximum reported mean length of stay in the United States in a systematic review of 30 studies was 24.9 days, which matches the current sample (Navarro et al., 2021; Tulloch et al., 2011), while in a review of high-income European nations the average length of stay for hospitalized psychiatric patients was 39.4 days (ranging from 17.9 mean days to 55).

Conclusion

The current study explored the same and next-day associations between a range of risk and protective factors for SAs in a clinical sample. Fluctuations in perceived burdensomeness, suicidal ideation, and hopelessness were significantly associated with near-term SAs. The high connectedness of hopelessness in SA networks

suggests it may also be an effective target during therapy to prevent patients attempting suicide. Fluctuations in cognitive-affective states, and suicidal ideation, may therefore provide a warning sign for SAs and targets during therapy. Incorporating measures of trait-like risk/protective factors is an important direction for future research, as well as further understanding the time scale in which risk and protective factors affect risk of SAs.

References

- Armev, M. F., Brick, L., Schatten, H. T., Nugent, N. R., & Miller, I. W. (2018). Ecologically assessed affect and suicidal ideation following psychiatric inpatient hospitalization. *General Hospital Psychiatry, 63*(2), 89–96. <https://doi.org/10.1016/j.genhosppsych.2018.09.008>
- Asparouhov, T., Hamaker, E. L., & Muthén, B. (2018). Dynamic structural equation models. *Structural Equation Modeling, 25*(3), 359–388. <https://doi.org/10.1080/10705511.2017.1406803>
- Asparouhov, T., & Muthén, B. (2010). *Bayesian analysis using Mplus: Technical implementation*. Citeseer. <https://www.statmodel.com/download/Bayes2.pdf>
- Australian Bureau of Statistics. (2021). *Causes of death, Australia, 2020*. <https://www.abs.gov.au/statistics/health/causes-death/causes-death-australia/latest-release>
- Bagge, C. L., Glenn, C. R., & Lee, H.-J. (2013). Quantifying the impact of recent negative life events on suicide attempts. *Journal of Abnormal Psychology, 122*(2), 359–368. <https://doi.org/10.1037/a0030371>
- Bagge, C. L., Littlefield, A. K., & Glenn, C. R. (2017). Trajectories of affective response as warning signs for suicide attempts: An examination of the 48 hours prior to a recent suicide attempt. *Clinical Psychological Science, 5*(2), 259–271. <https://doi.org/10.1177/2167702616681628>
- Beck, A. T. (1996). Beyond belief: A theory of modes, personality, and psychopathology. In P. M. Salkovskis (Ed.), *Frontiers of cognitive therapy* (pp. 1–25). The Guilford Press.
- Beck, A. T., Kovacs, M., & Weissman, A. (1979). Assessment of suicidal intention: The scale for suicide ideation. *Journal of Consulting and Clinical Psychology, 47*(2), 343–352. <https://doi.org/10.1037/0022-006X.47.2.343>
- Bentley, K. H., Coppersmith, D. L., Kleiman, E. M., Nook, E. C., Mair, P., Millner, A. J., Reid-Russell, A., Wang, S. B., Fortgang, R. G., & Stein, M. B. (2021). Do patterns and types of negative affect during hospitalization predict short-term post-discharge suicidal thoughts and behaviors? *Affective Science, 2*(4), 484–494. <https://doi.org/10.1007/s42761-021-00058-6>
- Ben-Zeev, D., Young, M. A., & Depp, C. A. (2012). Real-time predictors of suicidal ideation: Mobile assessment of hospitalized depressed patients. *Psychiatry Research, 197*(1–2), 55–59. <https://doi.org/10.1016/j.psychres.2011.11.025>
- Bos, F. M., Snippe, E., Bruggeman, R., Wichers, M., & van der Krieke, L. (2019). Insights of patients and clinicians on the promise of the experience sampling method for psychiatric care. *Psychiatric Services, 70*(11), 983–991. <https://doi.org/10.1176/appi.ps.201900050>
- Brezo, J., Paris, J., & Turecki, G. (2006). Personality traits as correlates of suicidal ideation, suicide attempts, and suicide completions: A systematic review. *Acta Psychiatrica Scandinavica, 113*(3), 180–206. <https://doi.org/10.1111/j.1600-0447.2005.00702.x>
- Bringmann, L. F., & Eronen, M. I. (2018). Don't blame the model: Reconsidering the network approach to psychopathology. *Psychological Review, 125*(4), 606–615. <https://doi.org/10.1037/rev0000108>
- Bryan, C. J. (2020). The temporal dynamics of the wish to live and the wish to die among suicidal individuals. In A. C. Page & W. G. K. Stritzke (Eds.), *Alternatives to suicide: Beyond risk and toward a life worth living* (pp. 71–88). Elsevier Academic Press. <https://doi.org/10.1016/B978-0-12-814297-4.00004-2>
- Bryan, C. J., May, A. M., Thomsen, C. J., Allen, M. H., Cunningham, C. A., Wine, M. D., Taylor, K. B., Baker, J. C., Bryan, A. O., & Harris, J. A. (2022). Psychometric evaluation of the suicide cognitions scale-revised (SCS-R). *Military Psychology, 34*(3), 269–279. <https://doi.org/10.1080/08995605.2021.1897498>
- Bryan, C. J., & Rudd, M. D. (2016). The importance of temporal dynamics in the transition from suicidal thought to behavior. *Clinical Psychology: Science and Practice, 23*(1), 21–25. <https://doi.org/10.1111/cpsp.12135>
- Bryan, C. J., Rudd, M. D., Peterson, A. L., Young-McCaughan, S., & Wertenberger, E. G. (2016). The ebb and flow of the wish to live and the wish to die among suicidal military personnel. *Journal of Affective Disorders, 202*(3), 58–66. <https://doi.org/10.1016/j.jad.2016.05.049>
- Chen, Y.-L., Hsiung, P.-C., Chung, L., Chen, S.-C., & Pan, A.-W. (2013). Psychometric properties of the Mastery Scale-Chinese version: Applying classical test theory and Rasch analysis. *Scandinavian Journal of Occupational Therapy, 20*(6), 404–411. <https://doi.org/10.3109/11038128.2013.838999>
- Coppersmith, D. D., Ryan, O., Fortgang, R., Millner, A., Kleiman, E., & Nock, M. (2023). Mapping the timescale of suicidal thinking. *Psychological and Cognitive Sciences, 120*(17), Article e2215434120. <https://doi.org/10.1073/pnas.2215434120>
- Czyz, E. K., Horwitz, A. G., Arango, A., & King, C. A. (2019). Short-term change and prediction of suicidal ideation among adolescents: A daily diary study following psychiatric hospitalization. *Journal of Child Psychology and Psychiatry, 60*(7), 732–741. <https://doi.org/10.1111/jcpp.12974>
- Dyer, K., Hooke, G., & Page, A. (2014). Development and psychometrics of the five item daily index in a psychiatric sample. *Journal of Affective Disorders, 152–154*(1), 409–415. <https://doi.org/10.1016/j.jad.2013.10.003>
- Dyer, K., Hooke, G., & Page, A. (2016). Effects of providing domain specific progress monitoring and feedback to therapists and patients on outcome. *Psychotherapy Research, 26*(3), 297–306. <https://doi.org/10.1080/10503307.2014.983207>
- Eklund, M., Erlandsson, L.-K., & Hagell, P. (2012). Psychometric properties of a Swedish version of the Pearlin Mastery Scale in people with mental illness and healthy people. *Nordic Journal of Psychiatry, 66*(6), 380–388. <https://doi.org/10.3109/08039488.2012.656701>
- Epskamp, S., Borsboom, D., & Fried, E. I. (2018). Estimating psychological networks and their accuracy: A tutorial paper. *Behavior Research Methods, 50*(1), 195–212. <https://doi.org/10.3758/s13428-017-0862-1>
- Epskamp, S., Waldorp, L. J., Möttus, R., & Borsboom, D. (2018). The Gaussian graphical model in cross-sectional and time-series data. *Multivariate Behavioral Research, 53*(4), 453–480. <https://doi.org/10.1080/00273171.2018.1454823>
- Fliege, H., Lee, J.-R., Grimm, A., & Klapp, B. F. (2009). Risk factors and correlates of deliberate self-harm behavior: A systematic review. *Journal of Psychosomatic Research, 66*(6), 477–493. <https://doi.org/10.1016/j.jpsychores.2008.10.013>
- Franklin, J. C., Ribeiro, J. D., Fox, K. R., Bentley, K. H., Kleiman, E. M., Huang, X., Musacchio, K. M., Jaroszewski, A. C., Chang, B. P., & Nock, M. K. (2017). Risk factors for suicidal thoughts and behaviors: A meta-analysis of 50 years of research. *Psychological Bulletin, 143*(2), 187–232. <https://doi.org/10.1037/bul0000084>
- Goldstein, T. R., Ha, W., Axelson, D. A., Goldstein, B. I., Liao, F., Gill, M. K., Ryan, N. D., Yen, S., Hunt, J., & Hower, H. (2012). Predictors of prospectively examined suicide attempts among youth with bipolar disorder. *Archives of General Psychiatry, 69*(11), 1113–1122. <https://doi.org/10.1001/archgenpsychiatry.2012.650>
- Goods, N. A., Page, A. C., Stritzke, W. G., Kyron, M. J., & Hooke, G. R. (2020). Daily monitoring of the wish to live and the wish to die with suicidal inpatients. In A. C. Page & W. G. K. Stritzke (Eds.), *Alternatives to suicide* (pp. 89–110). Elsevier.
- Green, K. L., Brown, G. K., Jager-Hyman, S., Cha, J., Steer, R. A., & Beck, A. T. (2015). The predictive validity of the beck depression inventory suicide item. *The Journal of Clinical Psychiatry, 76*(12), 1683–1686. <https://doi.org/10.4088/JCP.14m09391>

- Gunnell, D., Metcalfe, C., While, D., Hawton, K., Ho, D., Appleby, L., & Kapur, N. (2012). Impact of national policy initiatives on fatal and non-fatal self-harm after psychiatric hospital discharge: Time series analysis. *British Journal of Psychiatry*, *201*(3), 233–238. <https://doi.org/10.1192/bjp.bp.111.104422>
- Hallensleben, N., Glaesmer, H., Forkmann, T., Rath, D., Strauss, M., Kersting, A., & Spangenberg, L. (2019). Predicting suicidal ideation by interpersonal variables, hopelessness and depression in real-time. An ecological momentary assessment study in psychiatric inpatients with depression. *European Psychiatry*, *56*(1), 43–50. <https://doi.org/10.1016/j.eurpsy.2018.11.003>
- Hedegaard, H., Curtin, S. C., & Warner, M. (2018). *Suicide rates in the United States continue to increase*. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics.
- Hill, R. M., & Pettit, J. W. (2014). Perceived burdensomeness and suicide-related behaviors in clinical samples: Current evidence and future directions. *Journal of Clinical Psychology*, *70*(7), 631–643. <https://doi.org/10.1002/jclp.22071>
- Horwitz, A. G., Czyz, E. K., & King, C. A. (2015). Predicting future suicide attempts among adolescent and emerging adult psychiatric emergency patients. *Journal of Clinical Child & Adolescent Psychology*, *44*(5), 751–761. <https://doi.org/10.1080/15374416.2014.910789>
- James, K., Stewart, D., & Bowers, L. (2012). Self-harm and attempted suicide within inpatient psychiatric services: A review of the literature. *International Journal of Mental Health Nursing*, *21*(4), 301–309. <https://doi.org/10.1111/j.1447-0349.2011.00794.x>
- Joiner, T. E. (2005). *Why people die by suicide*. Harvard University Press.
- Joiner, T. E. (2007). *Why people die by suicide*. Harvard University Press.
- Joiner, T. E., Gencoz, F., Gencoz, T., Metalsky, G. I., & Rudd, M. D. (2001). The relation of self-hatred and suicidality in people with schizophrenia-spectrum symptoms. *Journal of Psychopathology and Behavioral Assessment*, *23*(2), 107–115. <https://doi.org/10.1023/A:1010915709011>
- Joiner, T. E., Van Orden, K. A., Witte, T. K., & Rudd, M. D. (2009). *The interpersonal theory of suicide: Guidance for working with suicidal clients*. American Psychological Association.
- Kaurin, A., Dombrowski, A. Y., Hallquist, M. N., & Wright, A. G. (2022). Integrating a functional view on suicide risk into idiographic statistical models. *Behaviour Research and Therapy*, *150*, Article 104012. <https://doi.org/10.1016/j.brat.2021.104012>
- Kessler, R. C. (2019). Clinical epidemiological research on suicide-related behaviors—where we are and where we need to go. *JAMA Psychiatry*, *76*(8), 777–778. <https://doi.org/10.1001/jamapsychiatry.2019.1238>
- Kiekens, G., Robinson, K., Tatnell, R., & Kirtley, O. (2021). Opening the black box of daily life in non-suicidal self-injury research: With great opportunity comes great responsibility. *JMIR Mental Health*, *8*(11), Article e30915. <https://doi.org/10.2196/30915>
- Kleiman, E. M., Turner, B. J., Fedor, S., Beale, E. E., Huffman, J. C., & Nock, M. K. (2017). Examination of real-time fluctuations in suicidal ideation and its risk factors: Results from two ecological momentary assessment studies. *Journal of Abnormal Psychology*, *126*(6), 726–738. <https://doi.org/10.1037/abn0000273>
- Kleiman, E. M., Turner, B. J., Fedor, S., Beale, E. E., Picard, R. W., Huffman, J. C., & Nock, M. K. (2018). Digital phenotyping of suicidal thoughts. *Depression and Anxiety*, *35*(7), 601–608. <https://doi.org/10.1002/da.22730>
- Klonsky, E. D., & May, A. M. (2015). The three-step theory (3ST): A new theory of suicide rooted in the “ideation-to-action” framework. *International Journal of Cognitive Therapy*, *8*(2), 114–129. <https://doi.org/10.1521/ijct.2015.8.2.114>
- Kyron, M. J., Hooke, G. R., Bryan, C. J., Kiekens, G., Chen, W., Hasking, P., & Page, A. C. (2023). Daily prediction of nonsuicidal self-injury among inpatients: The roles of suicidal thoughts, interpersonal difficulties, hopelessness, and affect. *Journal of Consulting and Clinical Psychology*, *91*(6), 323–336. <https://doi.org/10.1037/ccp0000812>
- Kyron, M. J., Hooke, G. R., Bryan, C. J., & Page, A. C. (2022). Distress tolerance as a moderator of the dynamic associations between interpersonal needs and suicidal thoughts. *Suicide and Life-Threatening Behavior*, *52*(1), 159–170. <https://doi.org/10.1111/sltb.12814>
- Kyron, M. J., Hooke, G. R., & Page, A. C. (2018). Daily assessment of interpersonal factors to predict suicidal ideation and non-suicidal self-injury in psychiatric inpatients. *Journal of Consulting and Clinical Psychology*, *86*(6), 556–567. <https://doi.org/10.1037/ccp0000305>
- Kyron, M. J., Hooke, G. R., & Page, A. C. (2019). Assessing interpersonal and mood factors to predict trajectories of suicidal ideation within an inpatient setting. *Journal of Affective Disorders*, *252*(6), 315–324. <https://doi.org/10.1016/j.jad.2019.04.029>
- Kyron, M. J., Hooke, G. R., & Page, A. C. (2020). Prediction and network modelling of self-harm through daily self-report and history of self-injury. *Psychological Medicine*, *51*(12), 1992–2002. <https://doi.org/10.1017/S0033291720000744>
- Lambert, M. J., & Harmon, K. L. (2018). The merits of implementing routine outcome monitoring in clinical practice. *Clinical Psychology: Science and Practice*, *25*(4), Article e12268. <https://doi.org/10.1111/cpsp.12268>
- Large, M. M., & Ryan, C. J. (2014). *Disturbing findings about the risk of suicide and psychiatric hospitals*. Springer.
- Lim, Z. X., Chua, W. L., Lim, W. S., Lim, A. Q., Chua, K. C., & Chan, E.-Y. (2022). Psychometrics of the Pearlin Mastery Scale among family caregivers of older adults who require assistance in activities of daily living. *International Journal of Environmental Research and Public Health*, *19*(8), Article 4639. <https://doi.org/10.3390/ijerph19084639>
- Linehan, M. M., Schmidt, H., III, Dimeff, L. A., Craft, J. C., Kanter, J., & Comtois, K. A. (1999). Dialectical behavior therapy for patients with borderline personality disorder and drug-dependence. *The American Journal on Addictions*, *8*(4), 279–292. <https://doi.org/10.1080/105504999305686>
- McNeish, D., & Hamaker, E. L. (2020). A primer on two-level dynamic structural equation models for intensive longitudinal data in Mplus. *Psychological Methods*, *25*(5), 610–635. <https://doi.org/10.1037/met0000250>
- Metalsky, G. I. & Joiner, T. E. (1997). The hopelessness depression symptom questionnaire. *Cognitive Therapy and Research*, *21*(3), 359–384. <https://doi.org/10.1023/A:1021882717784>
- Moller, C. I., Tait, R. J., & Byrne, D. G. (2013). Deliberate self-harm, substance use, and negative affect in nonclinical samples: A systematic review. *Substance Abuse*, *34*(2), 188–207. <https://doi.org/10.1080/08897077.2012.693462>
- Moritz, S., & Bartz-Beielstein, T. (2017). imputeTS: Time series missing value imputation in R. *The R Journal*, *9*(1), Article 207. <https://doi.org/10.32614/RJ-2017-009>
- Muthén, L., & Muthén, B. (2017). *Mplus user's guide* (Version 8.0). https://www.statmodel.com/download/usersguide/MplusUserGuideVer_8.pdf
- Myin-Germeys, I., Kasanova, Z., Vaessen, T., Vachon, H., Kirtley, O., Viechtbauer, W., & Reininghaus, U. (2018). Experience sampling methodology in mental health research: New insights and technical developments. *World Psychiatry*, *17*(2), 123–132. <https://doi.org/10.1002/wps.20513>
- Navarro, C., Alvarez Villalobos, F., Contreras Munoz, N. A., Guerrero Medrano, A. M., Tamayo Rodriguez, A. F., & Saucedo Uribe, E. (2021). Predictors of the length of stay of psychiatric inpatients: Protocol for a systematic review and meta-analysis. *Systematic Reviews*, *10*(10), 1–6. <https://doi.org/10.1186/s13643-020-01552-x>
- Newnam, E. A., Hooke, G. R., & Page, A. C. (2010). Monitoring treatment response and outcomes using the World Health Organization's Wellbeing Index in psychiatric care. *Journal of Affective Disorders*, *122*(1–2), 133–138. <https://doi.org/10.1016/j.jad.2009.06.005>
- Nock, M. K., Borges, G., Bromet, E. J., Alonso, J., Angermeyer, M., Beautrais, A., Bruffaerts, R., Chiu, W. T., De Girolamo, G., & Gluzman, S. (2008). Cross-national prevalence and risk factors for suicidal

- ideation, plans and attempts. *British Journal of Psychiatry*, 192(2), 98–105. <https://doi.org/10.1192/bjp.bp.107.040113>
- O'Connor, R. C. (2011). Towards an integrated motivational–volitional model of suicidal behaviour. In R. C. O'Connor, S. Platt & J. Gordon (Eds.), *International handbook of suicide prevention: Research, policy and practice* (pp. 181–198). Wiley Blackwell. <https://doi.org/10.1002/9781119998556.ch11>
- O'Connor, R. C., & Kirtley, O. J. (2018). The integrated motivational–volitional model of suicidal behaviour. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 373(1754), Article 20170268. <https://doi.org/10.1098/rstb.2017.0268>
- Pearlin, L. I., Menaghan, E. G., Lieberman, M. A., & Mullan, J. T. (1981). The stress process. *Journal of Health and Social Behavior*, 22(4), 337–356. <https://doi.org/10.2307/2136676>
- Qiu, T., Klonsky, E. D., & Klein, D. N. (2017). Hopelessness predicts suicide ideation but not attempts: A 10-year longitudinal study. *Suicide and Life-Threatening Behavior*, 47(6), 718–722. <https://doi.org/10.1111/sltb.12328>
- Ribeiro, J. D., Franklin, J., Fox, K. R., Bentley, K., Kleiman, E. M., Chang, B., & Nock, M. K. (2016). Self-injurious thoughts and behaviors as risk factors for future suicide ideation, attempts, and death: A meta-analysis of longitudinal studies. *Psychological Medicine*, 46(2), 225–236. <https://doi.org/10.1017/S0033291715001804>
- Ribeiro, J. D., Huang, X., Fox, K. R., & Franklin, J. C. (2018). Depression and hopelessness as risk factors for suicide ideation, attempts and death: Meta-analysis of longitudinal studies. *British Journal of Psychiatry*, 212(5), 279–286. <https://doi.org/10.1192/bjp.2018.27>
- Rodríguez, P., Marco Salvador, M. S., H, J., & García Alandete, J. (2017). The role of hopelessness and meaning in life in a clinical sample with non-suicidal self-injury and suicide attempts. *Psicothema*, 29(3), 323–328. <https://doi.org/10.7334/psicothema2016.284>
- Rudd, M. D. (2000). The suicidal mode: A cognitive-behavioral model of suicidality. *Suicide and Life-Threatening Behavior*, 30(1), 18–33. <https://doi.org/10.1111/j.1943-278X.2000.tb01062.x>
- Rudd, M. D. (2006). Fluid vulnerability theory: A cognitive approach to understanding the process of acute and chronic suicide risk. In T. E. Ellis (Ed.), *Cognition and suicide: Theory, research, and therapy* (pp. 355–368). American Psychological Association. <https://doi.org/10.1037/11377-016>
- Rudd, M. D., & Bryan, C. J. (2021). The brief suicide cognitions scale: Development and clinical application. *Frontiers in Psychiatry*, 12, Article 737393. <https://doi.org/10.3389/fpsy.2021.737393>
- Schultzberg, M., & Muthén, B. (2018). Number of subjects and time points needed for multilevel time-series analysis: A simulation study of dynamic structural equation modeling. *Structural Equation Modeling*, 25(4), 495–515. <https://doi.org/10.1080/10705511.2017.1392862>
- Shiffman, S., Stone, A. A., & Hufford, M. R. (2008). Ecological momentary assessment. *Annual Review of Clinical Psychology*, 4(1), 1–32. <https://doi.org/10.1146/annurev.clinpsy.3.022806.091415>
- Shneidman, E. S. (1993). Commentary: Suicide as psychache. *Journal of Nervous and Mental Disease*, 81(3), 145–147. <https://doi.org/10.1097/00005053-199303000-00001>
- Smith, P. C., Schmidt, S. M., & Allensworth-Davies, D. (2009). Primary care validation of a single-question alcohol screening test. *Journal of General Internal Medicine*, 24(7), 783–788. <https://doi.org/10.1007/s11606-009-0928-6>
- Tulloch, A. D., Fearon, P., & David, A. S. (2011). Length of stay of general psychiatric inpatients in the United States: Systematic review. *Administration and Policy in Mental Health and Mental Health Services Research*, 38(3), 155–168. <https://doi.org/10.1007/s10488-010-0310-3>
- Van Orden, K. A., Cukrowicz, K. C., Witte, T. K., & Joiner, T. E. (2012). Thwarted belongingness and perceived burdensomeness: Construct validity and psychometric properties of the Interpersonal Needs Questionnaire. *Psychological Assessment*, 24(1), 197–215. <https://doi.org/10.1037/a0025358>
- Victor, S. E., & Klonsky, E. D. (2014). Correlates of suicide attempts among self-injurers: A meta-analysis. *Clinical Psychology Review*, 34(4), 282–297. <https://doi.org/10.1016/j.cpr.2014.03.005>
- World Health Organization. (1998). *Info package: Mastering depression in primary care* (Version 2.2).
- World Health Organization. (2018). *Suicide data*. <https://www.who.int/teams/mental-health-and-substance-use/suicide-data>

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