Identifying Intersecting Factors Associated with Suicidal Thoughts and Behaviors among Transgender and Gender Diverse Adults: A Conditional Inference Tree Analysis

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Abstract

Background: Transgender and gender diverse (TGD) individuals are disproportionately impacted by suicidal thoughts and behaviors (STBs), and intersecting demographic and psychosocial factors may contribute to STB disparities.

Objective: In the U.S. Transgender Population Health Survey (N=274), we identified intersecting factors associated with increased risk for suicidal ideation, intent, plan, and attempts; and age of onset for each outcome using conditional inference trees.

Methods: This approach iteratively partitions samples into subgroups of greater homogeneity with respect to a specific outcome. In separate analyses, we (1) restricted variables to those typically available within electronic medical records (EMRs) and (2) expanded the variable set to include factors not typically within EMRs.

Results: In restricted analyses, younger adults endorsed more frequent ideation, intent, and planning, with intersecting younger age and receiving public assistance associated with increased ideation; no variables were associated with previous suicide attempts. Ages of onset for ideation, plan, and attempts were associated with the intersections of age and gender identity, sexual minority identity, and receiving public assistance. In expanded analyses, psychiatric distress was associated with ideation, intent, and planning, but not attempts. High distress intersecting with high healthcare stereotype threat (HST) was associated with increased ideation, with younger age and lower income exacerbating risk. High discrimination was associated with past attempts, with lower discrimination increasing risk in the context of high HST. Ages of onset for ideation, plan, and attempts were associated with intersecting age, distress, and HST; distress alone, intersecting distress and HST; and intersecting HST and discrimination.

Conclusions: In this initial test of the conditional inference tree approach to identifying key subgroups with increased STB risk, risk was primarily influenced by intersecting age, distress, HST, and income. Identifying intersecting factors liked to these outcomes is vital for early detection STB risk among TGD individuals. This approach should be tested on a larger scale utilizing EMR data to facilitate service provision to TGD individuals who are at increased risk for STBs.

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Conclusions: In this initial test of the conditional inference tree approach to identifying key subgroups with increased STB risk, risk was primarily influenced by intersecting age, distress, HST,

and income. Identifying intersecting factors liked to these outcomes is vital for early detection STB risk among TGD individuals. This approach should be tested on a larger scale utilizing EMR data to facilitate service provision to TGD individuals who are at increased risk for STBs.

Keywords: transgender and gender diverse adults; suicidality; intersectionality; conditional inference tree; electronic medical record

Introduction

Suicide is a leading cause of death in the United States [1], and transgender and gender diverse (TGD) individuals experience heightened risk for suicidal thoughts and behaviors (STBs). Lifetime prevalence of suicide attempts is 40% among gender minority individuals [2], relative to 4% in the general population [3]. In a recent analysis of Danish national hospital records, standardized suicide attempt rates per 100,000 person years were 498 for transgender individuals compared to 71 among individuals who were not transgender [4]. These disparities align with documented disparities in other areas, in that TGD individuals are at significantly greater risk for experiencing other mental health issues (e.g., depression, anxiety) [5–7], substance use disorders [8–10], bullying or victimization [11–13], and sexual abuse or intimate partner violence [14–16], in comparison to their cisgender peers.

Suicide disparities in TGD individuals are likely driven by multiple factors associated with marginalization (e.g., victimization and discrimination, internalized stigma, associated depression) [17,18] in combination with factors known to drive STBs in general samples (e.g., financial stress, unemployment, relationship problems, physical health problems) [19–21] and other suicide-specific theoretical drivers (e.g., thwarted belongingness, perceived burdensomeness) [22]. Minority stress theory suggests that individuals who hold stigmatized identities, across domains, experience disproportionately high stress that results from that stigma [11,23,24]. Within this framework, stigma-related stressors may be external to the self (e.g., harassment) and/or experienced internally as a result of consistent exposure to societal stigma (e.g., negative attitudes toward the self). TGD individuals bear a long history of experiencing societal discrimination and oppression, as well as substantial disparities in mental health outcomes compared to their cisgender counterparts [25]. These disparities are likely the result of

cisnormativity in society, and the prejudice associated with cisgenderism [26]—which may lead to bias and discrimination, harassment and violence, rejection and misgendering—and associated internal stressors (e.g., gender dysphoria, internalized transphobia or transnegativity) [27,28]. Indeed, several studies have demonstrated that the key pathways articulated via minority stress theory have strong empirical support among TGD populations [29–31]. TGD populations are also subject to the factors that drive STB risk in the general population as well as the psychological and interpersonal factors that are highlighted in established theoretical models of suicidality, including the interpersonal theory of suicide [22]. Indeed, recent research has integrated these theoretical models to suggest that the intersection of minority stressors and general suicide theoretical precursors drives STB risk in TGD people [32].

Emerging evidence also suggests that individuals exposed to intersectional forms of marginalization (e.g., transphobia *and* racism) may have unique experiences relative to individuals with one marginalized identity, and these unique experiences may lead to even worse health outcomes. Originally developed to describe the unique intersection of racism and sexism in the US [33–36], intersectionality simultaneously accounts for multiple forms of marginalization, investigates the social processes that perpetuate inequity, and explores the meaning of living in an intersectional position. Specifically, intersectional minority stress for multiply marginalized individuals may start in childhood. With continued discrimination and stigmatization across contexts, intersectional minority stress has been shown to persist and accumulate alongside adulthood stressors and distress, both of which are associated with suicide risk [37]. As applied to mental health and related constructs, intersectionality has been used to understand the nuances of concepts like stress, stigma, and resilience [38–40]. However, there has been little empirical research focused on identifying and quantifying the intersecting factors

that are associated with suicide in TGD adults.

Data-driven approaches to quantifying intersectionality have the potential to precisely identify groups that may have elevated risks of suicidal ideation (SI) and factors associated with SI and other suicide-related outcomes [41,42]. Researchers have called for more sophisticated and targeted statistical methods for studying intersectionality [43], especially to explore intersecting sociodemographic factors beyond the "big three" identifiers of race, gender, and socioeconomic status [41,44]. One such approach, known as the conditional inference tree [45], iteratively partitions samples into subgroups of greater homogeneity with respect to a specific outcome. Compared to mixture modeling (e.g., latent profile analysis for continuous data, latent class analysis for categorical data), the conditional inference tree allows for a more realistic representation of multivariate data due to its ability to approximate complex distributions and relations and to detect heterogeneity specific to an outcome. Conditional inference trees can also be more advantageous than conventional linear models, which focus on linear relationships only and often fail to account for the ways in which multiple factors interact in complex and nonlinear fashions to influence outcome variables [46]. The conditional inference tree approach allows for the characterization of distinct, empirically derived "profiles" or subgroups, characterized by the presence of multiple, co-occurring factors that together predict increased outcomes like SI, suicidal intent, or suicide plans.

Novel quantitative approaches for assessing intersectionality are necessary to examine (1) how sociodemographic and psychosocial factors are experienced in combination (i.e., how do demographic and psychosocial factors interact) and (2) how sociodemographic factors operate within socialized hierarchies and health systems (i.e., which factors are most associated with STBs). Given that inequities and disparities associated with different demographic and

psychosocial factors often combine to exacerbate negative health outcomes, identifying the intersecting factors associated with STBs will help elucidate how and where TGD individuals are situated in socialized hierarchies and systems.

Therefore, applying the conditional inference tree approach with potential applications for health systems in mind, this study identifies the intersecting factors that characterize subpopulations of TGD adults who are at increased risk for four different STBs (SI, intent, plan, history of previous attempts). We report two sets of analyses: one that restricts variables to those that are typically available within an electronic medical record (EMR; e.g., age, gender identity, ethnoracial identity, sexual orientation, public assistance status) and one that expands the set of variables to include urbanicity and psychosocial factors that are not commonly available within EMRs (e.g., discrimination, psychiatric distress, gender minority stress, alcohol use, drug use, social wellbeing, healthcare stereotype threat) but have demonstrated associations with STBs among TGD individuals. Discriminatory events are predictors of suicidal self-injury in this population [47], and transgender individuals who have experienced gender-based discrimination are approximately four times more likely to have attempted suicide than those who have not [48]. Both psychiatric distress (i.e., experiencing distress associated with psychological disorders), which is more prevalent among TGD individuals than cisgender individuals [49], and gender minority stress are associated with increased suicidal ideation and behaviors [50–53]. Substance use, especially in the context of co-occurring psychiatric distress and/or depression, has been associated with increased odds of suicidal ideation, plans, and attempts among transgender youth [54]. Social wellbeing is likely also linked to STBs among TGD individuals [55], and new data suggests that healthcare stereotype threat has a significant direct, adverse association with self-rated health and psychological distress among gender minority individuals [56], which may have

implications for suicide-related behaviors.

By leveraging data that are typically available in most EMRs, the first set of analyses will offer an initial test of a data-driven approach to identify TGD individuals that may need to be prioritized for additional risk assessment, appropriate resources, and/or treatment referrals in health systems and/or other clinical settings. The second set of analyses will offer more nuanced information on subgroups of TGD persons at increased risk for STBs and may inform the selection of measures that could be integrated into EMRs. Identifying these factors may also inform the development of systems-level approaches to prevent suicide among populations at increased risk.

Method

Participants

We included 274 TGD participants from the U.S. Transgender Population Health Survey (TransPop), a national probability sample of gender diverse adults in the United States that was conducted from 2016 to 2018. Probability sampling approaches were used to enhance diversity and representativeness of the sample [57]. See Krueger et al. [58] for further methodological details on the original study. The original study that concerned human subjects was IRB approved. Table 1 displays the demographics of the TransPop sample.

Measures

Sociodemographic variables

We considered the associations between seven sociodemographic variables and STBs: age, ethnoracial identity, gender identity, sexual minority status, urbanicity, public assistance status, and personal income. The study included participants from five ethnoracial groups: White (non-Hispanic), Black/African American, Latino/Hispanic/Spanish origin, multiracial, and other. Gender identity included three categories: Transgender man, Transgender Woman, and Gender

Queer/Non-binary. Sexual minority status was a binary variable indicating the presence or absence of a minoritized sexual identity. Urbanicity (urban vs. non-urban) was computed using respondents' zip codes based on the USDA Rural-Urban Commuting Area coding system. Public assistance status was indicative of receipt (1 vs. 0) of The Supplemental Nutrition Assistance Program or The Special Supplemental Nutrition Program for Women, Infants, and Children. Personal income (per year) was rated from no income to $150,000 or more in $5,000 increments.

Psychological/clinical variables

We also considered seven psychosocial variables: alcohol use, drug use, gender minority stress, experiences of discrimination, distress, social well-being, and healthcare stereotype threat.

Alcohol use

was measured using the Alcohol Use Disorder Identification Test (AUDIT- C), a 3-item scale designed to identify persons with hazardous drinking behavior, or who have active alcohol use disorders [59]. Items include monthly alcohol consumption frequency, daily alcohol consumption frequency, and binge drinking frequency. Each item was rated on a 5-point Likert scale from 0 to 4, and individual item scores were summed to create a total score, with higher scores indicating that the individual's alcohol use is negatively affecting their health and safety.

Drug use

Drug use was measured via the Drug Use Disorders Identification Test (DUDIT), an 11-item scale designed to identify individuals with drug-related problems and/or substance use disorders [60]. Each item was rated on a 5-point Likert scale from 0 to 4. The final variable was the sum of all variables in the scale, and a higher score indicates greater substance use.

Psychiatric distress

The Kessler-6 was used to assess psychiatric distress [61]. Scale items measure the frequency of the following emotions or experiences in the past 30 days: “nervous”, “hopeless”, “restless or fidgety”, “so depressed that nothing could cheer you up”, “that everything was an effort”, and “worthless”. Responses were recorded on a 5-point scale, ranging from “all of the time” to “none of the time.” All items were first reverse-coded so that “none of the time” had a value of 1 and “all of the time” had a value of 5. The final score was the sum of all individual item scores.

Variables related to gender minority identity

Gender minority stress

Gender minority stress was measured with four subscales of the Gender Minority Stress and Resilience (GMSR) measure [28]: (1) *Internalized transphobia* (e.g., “I resent my transgender identity”, and “I ask myself why I can’t just be normal?”) measures the degree to which individuals have internalized or integrated societal stigma into their own self-concepts; (2) *Non-affirmation of gender identity* (e.g., “I have to repeatedly explain my gender identity to people or correct the pronouns people use”, and “I have difficulty being perceived as my gender”) assesses the degree to which individuals feel that their gender identity is understood and accepted by others; (3) *Non-disclosure of gender identity* (e.g., “I don’t talk about certain experiences from my past or I change parts of what I will tell people”, and “I modify my way of speaking”) measures the degree to which individuals avoid disclosing their gender identity to others; and (4) *Negative expectations of the future* (e.g., “if I express my gender identity/history, others wouldn’t accept me,” and “if I express my gender identity/history, employers would not hire me”) assesses the degree to which an individual believes that they will not be understood or

accepted because of their gender identity in the future. Responses were recorded on 5-point Likert scales, ranging from “strongly disagree” to “strongly agree.” The mean scores of each subscale, which ranged from 1 to 5, were used in analyses.

Discrimination

The Everyday Discrimination Scale was used to assess daily experiences of discrimination or unfair treatment [62]. For example, scale items probe how often the following experiences occurred over the past year: “You were treated with less courtesy than other people,” “You were treated with less respect than other people,” and “You were called names or insulted.” Responses were recorded on a 4-point Likert scale, ranging from “often” to “never”. Scale values ranged from 1 to 4. The final score was the mean of all items. Higher values represent more everyday discrimination.

Healthcare stereotype threat

A modified 4-item version of Abdou & Fingerhut's [63] scale was used to assess the degree to which participants worried about being negatively judged by their healthcare providers or confirming stereotypes about LGBT people in healthcare settings (e.g., “I worry about being negatively judged because of my sexual orientation or gender identity”). Responses were recorded on a 5-point scale, ranging from “strongly disagree” to “strongly agree.” The mean score across all items was used in subsequent analyses, with lower values representing less worry about being judged or confirming LGBT stereotypes and higher values representing greater worry.

Variables related to well-being

Social well-being

Social well-being is defined as one's "appraisal of one's circumstances and functioning in society" [64]. The social well-being scale, developed by Keyes, that was included in the TransPop survey consists of 15 items (e.g., "I don't feel I belong to anything I'd call a community", "My community is a source of comfort", "I have something valuable to give to the world"), each rated on a 7-point Likert scale ranging from "strongly disagree" to "strongly agree". The mean score across all items was used; higher values represent greater social well-being. Final scores ranged from 1 to 7.

Primary outcomes

We assessed four types of STBs, which were measured by participants' responses to the questions in parentheses: (1) *suicidal ideation* ("Did you ever in your life have thoughts of killing yourself?"), (2) *suicidal intent* ("Did you ever have any intention to act on thoughts of wishing you were dead or trying to kill yourself?"), (3) *suicide plan* ("Did you ever think about how you might kill yourself, e.g., taking pills, shooting yourself, or work out a plan of how to kill yourself?"), and (4) *suicide attempt history* ("Did you ever make a suicide attempt, i.e., purposefully hurt yourself with at least some intention to die?"). Respondents rated each of the four STBs as "No," "Yes, once," or "Yes, more than once." In addition, if a participant endorsed a given outcome, they were additionally asked to provide the best estimate for the age of first onset of that outcome ("how old were you the very first time you…").

Statistical Analysis

We applied conditional inferences trees [45] to identify subgroups with intersecting demographic and psychosocial factors that are associated with increased likelihood of each of the

four suicidal outcomes. Conditional inference trees model the nonlinear relationships between a wide range of predictors and an outcome. As a data mining approach, the conditional inference tree is a data-driven analytic strategy that identifies interacting social determinants from many candidate predictors to determine which predictors are most relevant to specific outcomes. Conventionally, researchers have used generalized and general linear models with interaction terms, as informed by theory, to model intersectionality; these approaches are limited in that only a small number of predictors are typically examined simultaneously and confined by assumed additive and linear effects, and they require follow-up tests (e.g., Tukey's tests) to determine actionable groups that deserve additional attention [65,66]. Importantly, conditional inference trees can highlight the potential statistical predictor for the between-group differences (e.g., poverty as an additional intersectional factor for younger individuals experiencing suicidal ideation). This is advantageous for intersectionality research because our goal is not only to uncover subgroups that explain the heterogeneity in suicidal thoughts and behaviors but also to understand the *factors* associated with the heterogeneity. Lastly, conditional inference tree can effectively handle smaller sample sizes, as methodological research has shown reliable results with subgroup sizes as small as 10-20 participants [67].

We conducted two sets of analyses: First, we used variables that approximate basic data that may be collected in EMRs, with the understanding that health systems vary, as do the data that is typically collected in these records. These variables included age, gender identity, ethnoracial identity, sexual minority status, and public assistance status. This list was based on data that is consistently collected from patients within a large academic health system in the northeastern United States (US) *and* patients receiving care from a community health center, also in the northeastern US, with which study authors are affiliated. Second, we included the

following additional psychosocial variables in the models: urbanicity, alcohol use, drug use, psychiatric distress, specific constructs related to gender minority stress (internalized transphobia, non-affirmation of gender identity, non-disclosure of gender identity, negative expectations of the future), discrimination, healthcare stereotype threat, and social well-being. It is important to note that some of the variables included in the second set of analyses are sometimes collected in EMRs (e.g., in one report, 40% of patients had alcohol use documented in their EMRs) [68], but the demographic factors specified as variables in the first set may be more consistently available. For each set of analyses, we used conditional inference trees to examine the ordinal lifetime history of each of the four STBs, as well as age of first onset for those outcomes.

Results

Prevalence of STBs

In this sample (N=273), 80% (n=220) of participants endorsed SI, 55% (n=150) endorsed suicidal intent, 67% (n=184) endorsed having a suicide plan, and 36% (n=99) endorsed a history of suicide attempt(s), with 49 participants endorsing one previous suicide attempt and 50 participants endorsing more than one previous attempt. Table 1 provides participant demographics. Table 2 displays further descriptive statistics of study variables.

Table 1

Participant demographics

% (N)	Full sample	Transgender Men	Transgender Women	Gender nonbinary adults
Gender Identity	274	28.47% (78)	43.80% (120)	27.74% (76)
Age, M (SD)	39.36 (16.89)	34.71 (15.92)	46.18 (16.71)	33.38 (14.23)
Sexual minority identity	78.60% (213)	65.38% (51)	75.21% (88)	97.37% (74)
Urbanicity	79.20% (217)	82.05% (64)	74.17% (89)	84.21% (64)
Race				
White	68.25% (187)	64.10% (50)	70.83% (85)	68.42% (52)
Black	7.66% (21)	10.26% (8)	6.67% (8)	6.58% (5)
Latino	9.49% (26)	8.97% (7)	8.33% (10)	11.84% (9)
Multiracial	8.76% (24)	10.26% (8)	8.33% (10)	7.89% (6)
Other	5.84% (16)	6.41% (5)	5.83% (7)	5.26% (4)
Personal income				
No income	5.84% (16)	5.13% (4)	5.00% (6)	7.89% (6)
$1 to $4,999	9.85% (27)	16.67% (13)	5.00% (6)	10.53% (8)
$5,000 to $9,999	12.04% (33)	10.26% (8)	15.00% (18)	9.21% (7)
$10,000 to $14,999	10.58% (29)	12.82% (10)	6.67% (8)	14.47% (11)
$15,000 to $19,999	10.95% (30)	10.26% (8)	11.67% (14)	10.53% (8)
$20,000 to $24,999	5.84% (16)	6.41% (5)	5.83% (7)	5.26% (4)
$25,000 to $29,999	4.74% (13)	7.69% (6)	4.17% (5)	2.63% (2)
$30,000 to $39,999	7.66% (21)	7.69% (6)	6.67% (8)	9.21% (7)
$40,000 to $49,999	7.30% (20)	5.13% (4)	6.67% (8)	10.53% (8)
$50,000 to $59,999	6.93% (19)	7.69% (6)	6.67% (8)	6.58% (5)
$60,000 to $74,999	3.65% (10)	2.56% (2)	4.17% (5)	3.95% (3)
$75,000 to $99,999	5.84% (16)	2.56% (2)	10.00% (12)	2.63% (2)
$100,000 to $149,999	5.47% (15)	3.85% (3)	8.33% (10)	2.63% (2)
$150,000 or more	3.28% (9)	1.28% (1)	4.17% (5)	3.95% (3)

Table 2

Descriptive statistics of study variables

Mean (SD) or % (N)	Full sample	Transgender men	Transgender women	Gender nonbinary adults
Alcohol use	2.14 (2.04)	1.77 (1.84)	2.13 (2.13)	2.53 (2.02)
Drug use	3.95 (6.27)	3.18 (5.41)	3.38 (5.89)	5.64 (7.36)
Psychiatric distress	9.26 (5.85)	8.59 (5.54)	8.7 (6.18)	10.83 (5.38)
Everyday discrimination	2.07 (0.79)	2.00 (0.78)	2.03 (0.82)	2.2 (0.75)
Social wellbeing	4.46 (0.95)	4.46 (0.85)	4.52 (0.93)	4.37 (1.08)
Healthcare stereotype threat	3.28 (1.18)	3.37 (1.11)	3.04 (1.28)	3.59 (0.99)
Non-affirmation of gender identity	2.98 (1.25)	2.60 (1.35)	2.75 (1.19)	3.74 (0.89)
Gender identity non-disclosure	3.39 (0.91)	3.47 (0.88)	3.41 (0.93)	3.27 (0.9)
Internalized homophobia	2.64 (1.01)	2.74 (0.98)	2.69 (1.02)	2.46 (1)
Negative expectations of the future	3.18 (0.92)	3.08 (0.96)	3.11 (0.94)	3.38 (0.80)
Lifetime suicidal ideation				
No	19.41% (53)	18.18% (14)	25.00% (30)	11.84% (9)
Yes, once	15.75% (43)	11.69% (9)	20.00% (24)	13.16% (10)
Yes, more than once	64.84% (177)	70.13% (54)	55.00% (66)	75.00% (57)
Lifetime suicidal intent				
No	45.05% (123)	38.96% (30)	55.83% (67)	34.21% (26)
Yes, once	19.41% (53)	22.08% (17)	15.00% (18)	23.68% (18)
Yes, more than once	35.53% (97)	38.96% (30)	29.17% (35)	42.11% (32)
Lifetime suicide plan				
No	32.60% (89)	25.97% (20)	40.00% (48)	27.63% (21)
Yes, once	17.58% (48)	19.48% (15)	18.33% (22)	14.47% (11)
Yes, more than once	49.82% (136)	54.55% (42)	41.67% (50)	57.89% (44)
Lifetime suicide attempt				
No	63.74% (174)	58.44% (45)	67.50% (81)	63.16% (48)
Yes, once	17.95% (49)	22.08% (17)	17.50% (21)	14.47% (11)
Yes, more than once	18.32% (50)	19.48% (15)	15.00% (18)	22.37% (17)

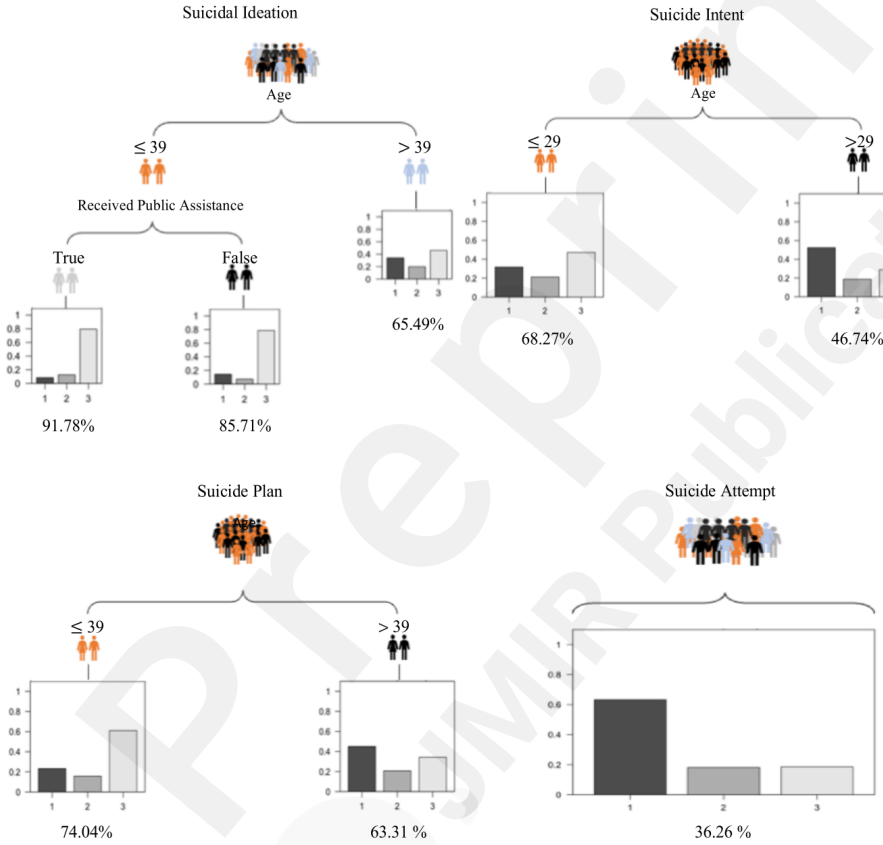
EMR-specific variables associated with STBs

Figure 1 presents the intersection of EMR-related variables (age, gender identity, ethnoracial identity, sexual minority status, and public assistance status) that was associated with lifetime history of SI, suicidal intent, suicide plans, and suicide attempts. Age appeared to be a consistent factor impacting SI, intent, and plan, such that younger adults endorsed more frequent SI, intent, and plans. For SI, public assistance status additionally differentiated adults younger

than 40 years old; individuals who received public assistance were more likely to endorse lifetime history of SI. Importantly, no EMR-related variables were able to sufficiently predict history of suicide attempts.

Figure 1

Tree diagrams for EMR-related variables predicting lifetime history of suicidal ideation, suicide intent, suicide plan, and suicide attempt



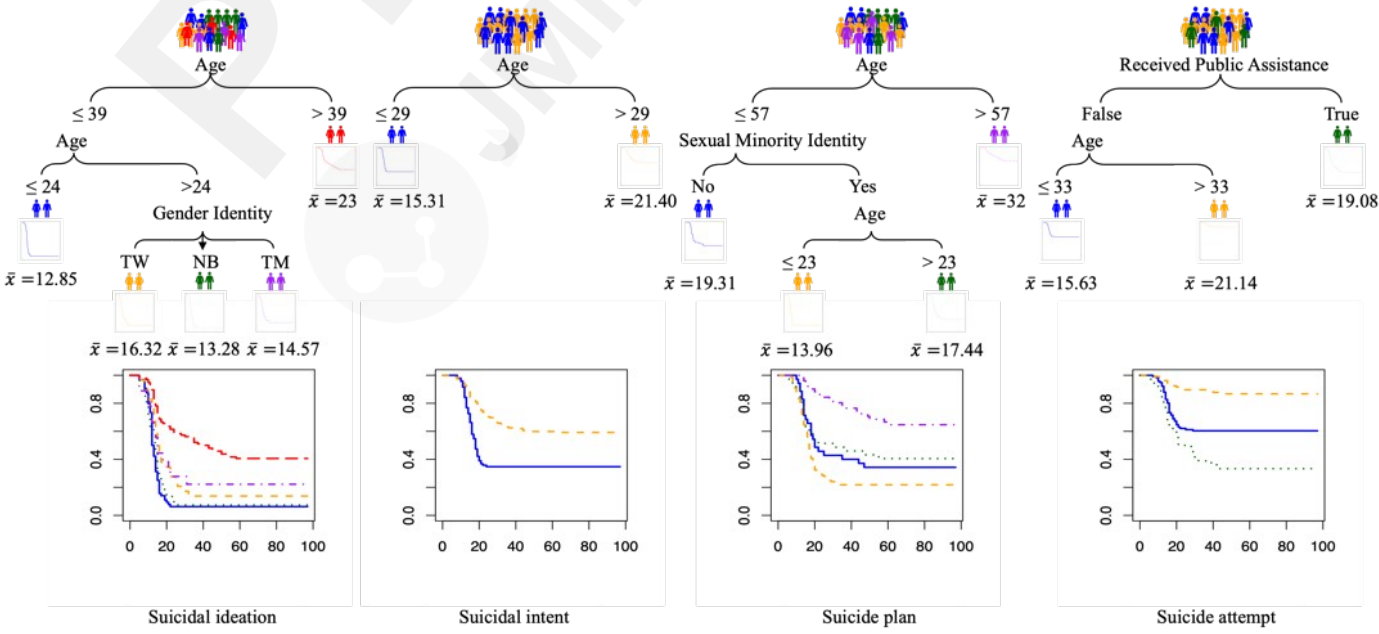
Note. The four decision tree diagrams represent subgroups of participants based on the values of predictor variables for EMR-related variables for questions about history of suicidal ideation, suicidal intent, suicide plan, and suicide attempt. Each terminal node displays the percentages of participants who responded 1-"No", 2-"Yes, once" and 3-"Yes, more than once" to questions about their history. The percentages below the terminal nodes represent the percent of

participants in each subgroup that indicated having any history of suicidal ideation, intent, plan, or attempt.

Figure 2 presents the intersection of EMR-related variables that was associated with age of onset for SI, intent, plan, and history of previous attempts. With respect to suicidal thoughts (ideation, intent, and plan), age of onset was meaningfully and primarily differentiated by age, such that older adults were older when they first time experienced the three types of suicidal thoughts. With respect to a history of previous suicide attempts, receiving public assistance differentiated age of onset; that is, TGD adults receiving public assistance had the earliest age of previous attempts. Additionally, among individuals who did not receive public assistance, those aged 33 years or younger had an earlier age of onset for previous attempts than those aged 34 and older.

Figure 2

Tree diagrams for EMR-related variables predicting age of onset for suicidal ideation, suicide intent, suicide plan, and suicide attempt



Note. The four decision tree diagrams represent subgroups of participants based on the values of predictor variables for EMR-related variables. The mean values below the terminal nodes are onset age means for each subgroup. Each terminal node displays the survival curve indicating the probability of participants in that subgroup not having a history of suicidal ideation, intent, plan, or attempt and are combined in the bottom plots.

Abbreviations. TW=transgender women; TM=transgender men; NB=gender nonbinary

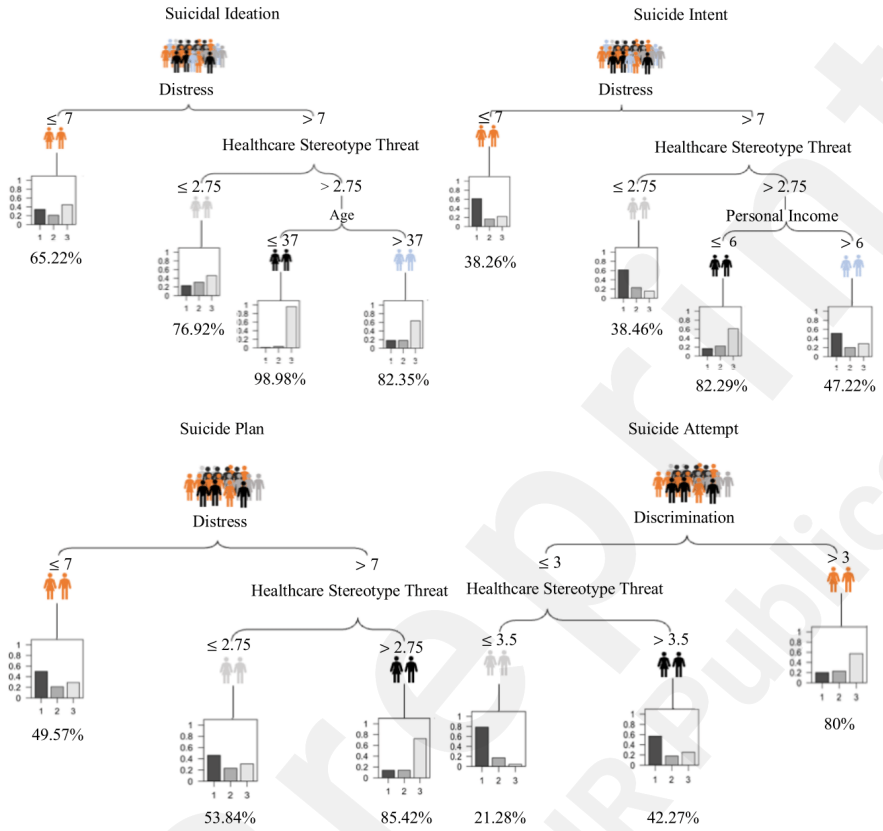
Including additional psychosocial variables to examine associations with STBs

Figure 3 delineates the intersection of variables that was associated with lifetime history of the four STBs. To conduct this analysis, all variables (EMR specific variables plus urbanicity and the additional psychosocial variables) were examined. Psychiatric distress was consistently demonstrated to be the primary differentiating factor for SI, intent, and plan; that is, adults with higher psychiatric distress were more likely to endorse a lifetime history of all three types of suicidal thinking. With respect to predicting previous suicide attempt(s), experiencing higher levels of discrimination was the primary differentiating factor, with higher discrimination positively associated with lifetime history of attempt(s).

INTERSECTING FACTORS ASSOCIATED WITH SUICIDALITY IN TGD ADULTS

Figure 3

Tree diagrams for the expanded set of variables predicting lifetime history of suicidal ideation, suicide intent, suicide plan, and suicide attempt



Note. The four decision tree diagrams represent subgroups of participants based on the values of predictor variables for EMR-related plus psychosocial variables for questions about history of suicidal ideation, suicidal intent, suicide plan, and suicide attempt. Each terminal node displays the percentages of participants who responded 1-"No", 2-"Yes, once" and 3-"Yes, more than once" to questions about their history. The percentages below the terminal nodes represent the percent of participants in each subgroup that indicated having any history of suicidal ideation, intent, plan, or attempt.

Healthcare stereotype threat emerged as a consistent secondary factor for identifying persons at increased risk for all four STBs. Among TGD adults experiencing higher psychiatric

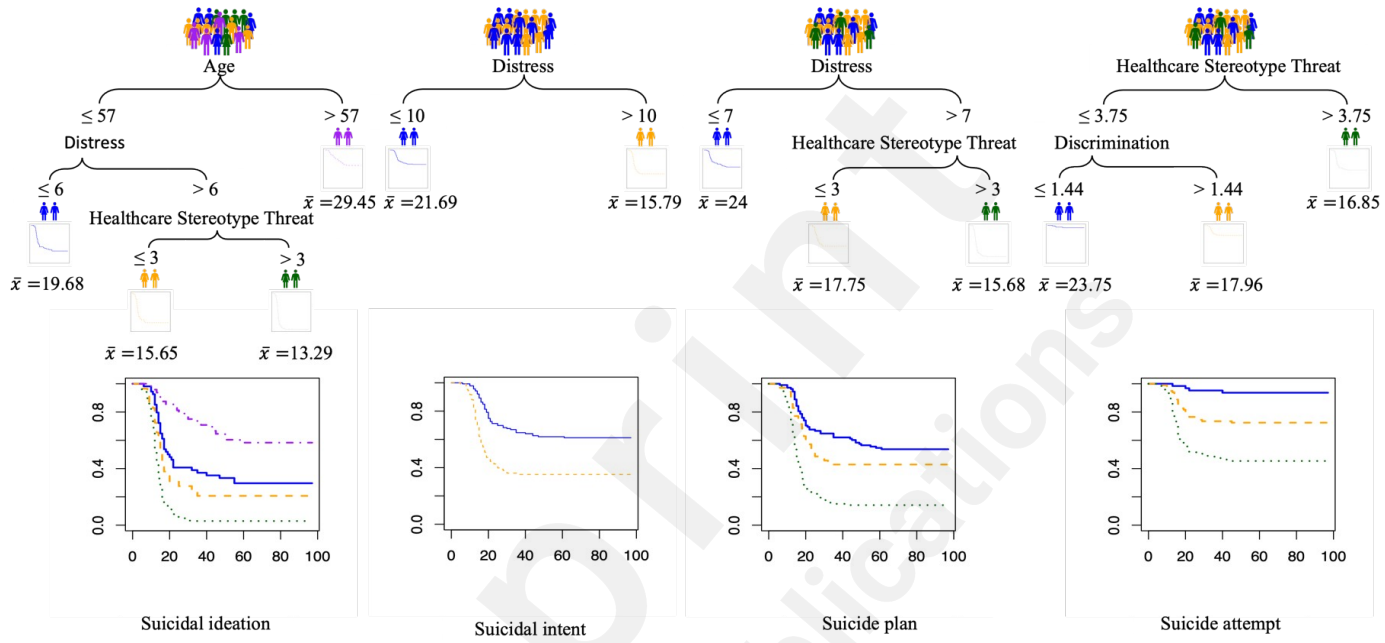
distress, those who had lower healthcare stereotype threat had lower odds of SI, suicidal intent, or suicide plan. Among TGD adults who experienced less everyday discrimination, those who also had lower healthcare stereotype threat had decreased odds of a previous suicide attempt(s).

Tertiary factors intersecting with the variables described above also emerged for SI and intent. With respect to SI, age was a tertiary factor: among adults with both high psychiatric distress and high healthcare stereotype threat, those aged 37 or younger were significantly more likely to endorse ideation than older adults. Personal income was a tertiary factor for suicidal intent, such that adults with incomes below $25,000 per year were significantly more likely to endorse a lifetime history of suicidal intent than those with higher incomes.

Figure 4 presents the intersection of all included variables predicting age of onset for each of the four suicide outcomes. For SI, older adults (age > 57) had significantly later age of onset. Among younger individuals, those experiencing lower psychiatric distress and those with high psychiatric distress but low healthcare stereotype threat shared a similar and earlier age of onset. Overall, younger adults (age < 58) who experienced high psychiatric distress and endorsed high healthcare stereotype threat reported the earliest age of onset for SI. With respect to suicide intent and plans, adults with high psychiatric distress had a significantly earlier age of onset. Additionally, healthcare stereotype threat emerged as a secondary factor, such that adults with both high psychiatric distress and high healthcare stereotype threat had the earliest age of onset of planning for suicide. Finally, with respect to previous suicide attempt(s), experiencing high healthcare stereotype threat was associated with earliest age of onset, and discrimination emerged as a secondary factor, such that adults experiencing low healthcare stereotype threat *and* high levels of discrimination had an earlier age of onset for previous attempts than those with both low levels of healthcare stereotype threat and discrimination.

Figure 4

Tree diagrams for the expanded set of variables predicting age of onset for suicidal ideation, suicide intent, suicide plan, and suicide attempt



Note. The four decision tree diagrams represent subgroups of participants based on the values of predictor variables for EMR-related variables plus psychosocial variables. The mean values below the terminal nodes are onset age means for each subgroup. Each terminal node displays the survival curve indicating the probability of participants in that subgroup not having a history of suicidal ideation, intent, plan, or attempt and are combined in the bottom plots.

Discussion

In this population-based sample of TGD adults, we identified the following intersecting factors as significant predictors of at least one of the four STBs: age, receiving public financial assistance, psychiatric distress, healthcare stereotype threat, discrimination, and income. In addition, across both the limited set of variables intended to approximate data available in an EMR and the expanded set of variables that included additional psychosocial constructs, analyses revealed that different intersections of age, sexual orientation, gender identity, receiving

public financial assistance, psychiatric distress, discrimination, and healthcare stereotype threat was associated with age of onset of the four STBs. Identifying the intersectional factors that are associated with increased risk for suicidal thoughts and behaviors, as well as ages of onset for those outcomes, is an important step in identifying points of intervention, especially at the health-systems level.

When we restricted the variables to data that may be available within EMRs, younger age and receipt of public assistance were consistent predictors of suicidal thoughts (ideation, intent, plan), whereas none of the variables in the restricted data set were able to predict previous suicide attempts. In a large, representative sample (over 250,000 respondents) of the general U.S. population, pulled from the National Survey on Drug Use and Health (NSDUH), past year prevalence of suicide-related thoughts and planning was higher among adults between the ages of 18 and 39 than among those aged 40 and older [69]. Age-related differences in SI have also been documented across cultures, including in a South Korean sample [70], in which young adults were more likely than older adults to experience significant SI, regardless of depression severity. In the current analysis, receiving public assistance intersected with age for SI, such that individuals younger than age 40 who received assistance were more likely to endorse ideation. This finding replicated one of the results of the NSDUH study in the general adult population, which indicated that the prevalence of suicide attempts was higher among those living in poverty and those covered by Medicaid or the Children's Health Insurance Program than among those with a family income at or above the federal poverty level and those with other types of insurance, respectively. The intersection of age-related SI disparities with socio-economic inequality suggests that the confluence of both factors may indicate a need for suicide-related screening among younger TGD adults facing economic challenges, as well as the need to identify

suicide prevention strategies that attend to socioeconomic inequities.

When additional psychosocial variables were added to the models, recent psychiatric distress was the differentiating factor for suicidal thoughts (ideation, intent, and plan), and secondary/tertiary intersecting factors included healthcare stereotype threat, age, and income. Notably, the tool used to measure psychiatric distress primarily focused on negative affect, anxiety, and depression symptoms, rather than other forms of emotional distress (like anger, which has been linked to suicide risk [71]. In general, integrating self-reported data with EMR data appears to improve suicide risk prediction models [72]. Although we were able to identify some intersecting factors associated with increased risk of suicidal thoughts when the model included only the variables that approximated those typically found in EMRs, the addition of other relevant constructs for TGD adults, especially healthcare stereotype threat, offers unique insights on factors that could be assessed and intervened upon in health systems. Defined as the fear of confirming negative stereotypes by one's group and the fear that one's group status negatively influences how medical providers evaluate and diagnose patients [63], healthcare stereotype threat has been associated with increased anxiety, distrust of providers, and decreased adherence to health behaviors [63,73]. Importantly, patients for whom suicide risk associated with healthcare stereotype threat is highly relevant may be most likely to be missing/underrepresented in EMR assessments of risk; that is, healthcare stereotype threat may serve as a variable leading to disparities in receipt of needed care. The inclusion of healthcare stereotype threat in these analyses is therefore a unique and important addition that extends beyond variables that are typically included in EMR studies of suicide risk.

Evidence suggests that, in addition to navigating daily discrimination and stigmatization in their communities, TGD individuals may be confronted by harmful stereotypes in the medical

setting, and interactions with health care providers and institutions may have an impact on health and well-being disparities [74–76]. In the one other study that has examined this construct among TGD adults, healthcare stereotype had a direct adverse association with self-rated health and psychological distress, even after accounting for experiencing discrimination and stigma [56]. Although healthcare stereotype has clear construct-level overlap with both discrimination and stigma, focusing on mitigating stigma in the healthcare setting specifically may be an important target for interventions aimed at reducing suicide risk disparities among TGD persons. Other factors that intersected with psychiatric distress and healthcare stereotype threat were age and income, such that high psychiatric distress, high healthcare stereotype threat, and young age were associated with increased SI, and high psychiatric distress, high stereotype threat, and low income were associated with increased suicidal intent. As described above, both young age and low income have been associated with poor suicide-related outcomes in other samples, indicating that both developmental and socioeconomic factors may play contribute to risk for suicidal thinking [56,63,73]. It is also possible that younger individuals may feel more directly impacted by the current sociopolitical climate and associated restrictions on access to gender-affirming care across the country.

In addition, experiencing everyday discrimination was a key differentiating factor in predicting previous suicide attempts, with healthcare stereotype threat again emerging as a secondary, intersecting factor. There is an established association between discrimination and suicide deaths or history of suicide attempts among TGD individuals (Clements-Nolle et al., 2006) that has also been confirmed in recent studies. For example, in an Australian study of TGD adults conducted in 2021, institutional discrimination (i.e., from employment, housing, accessing healthcare and/or government services) related to their gender identity was positively associated

with a history of suicide attempts [77]. Among TGD adults in the current sample, those who experienced everyday discrimination were most likely to endorse a history of suicide attempts, followed by individuals who had low everyday discrimination but high healthcare stereotype threat, again suggesting that healthcare stereotype threat may be a meaningful intervention target. These data align with stressors that have been documented in free-text clinical notes with TGD patients in medical visits that took place prior to suicide attempts; over half had evidence of being misgendered in the healthcare system, and at times, patient reports of having been misgendered within the health system were directly documented in the clinical notes [78]. These instances of bias and discrimination in healthcare settings may further discourage TGD patients from disclosing suicidal ideation [79] and from seeking mental health care, even when they are at acute risk of suicide.

For both the limited, EMR-specific and the expanded set of predictor variables, earlier age of onset for suicidal thoughts was associated with the following variables and their intersections: current age (younger), receiving public assistance, gender identity (nonbinary adults older than 24 years of age had earliest age of ideation onset, relative to transgender women and men), sexual minority identity, high distress, high healthcare stereotype threat, and more experiences of everyday discrimination. Within the analyses that relied on data typically contained in EMRs, current age alone ($\leq$ 29 years) was a meaningful predictor of early onset for suicidal intent; for the other three outcomes (i.e., SI, plan, attempts), the intersection of current age and other factors (gender identity, sexual minority identity, and public assistance) provided additional insight on the specific subgroups of TGD adults who may be at greatest risk for STBs. Adding additional psychosocial variables offered further clarity on which intersection points were associated with earliest onset *and*, most importantly, suggested intersecting factors that may

be modifiable. The intersection of high distress and high healthcare stereotype threat, for example, were associated with earlier age of onset for both SI and suicide planning; both factors could be addressed in multi-level, psychosocial interventions that focus on improving both individual-level coping and provider-level skills in suicide risk assessment, communication, and/or provision of resources that are relevant and meaningful to TGD adults. To our knowledge, no other studies have identified intersectional factors that predict age of onset for suicidal thoughts and behaviors among TGD individuals.

Several limitations of the current study warrant mention and point to important future directions for use of the conditional inference tree approach in suicidality research among TGD persons as well as other populations at increased risk. First, the small sample size may preclude identification of important factors that had weak or variable effects, as the statistical power to detect such effects is limited in a smaller data set. Despite this limitation, the use of conditional inference trees is a robust approach for smaller samples, as it effectively handles complex interactions and avoids overfitting through unbiased variable selection. This allows us to identify and interpret the most significant relationships in the data, even with a relatively small sample. Nonetheless, subsequent studies should therefore seek to use larger samples pulled from EMRs to identify more nuanced subgroups within health symptoms that may be at increased risk for STBs. Similarly, despite a larger set of factors associated with STBs that were considered in the current study compared to previous research, consideration of other factors beyond demographic and/or psychosocial variables may aid in identification of subgroups who are at elevated risk of suicidal thoughts and behaviors, should such variables be accessible within larger data sets. Again, because the current study used variables to approximate those common to EMRs, replication of our findings with data that have actually been extracted from health systems across

regions is important to evaluate the appropriateness and clinical applicability of the conditional inference tree approach for use with EMR data. Notably, the authors' affiliations with community health clinics and large academic medical centers located in the northeastern US may have led to the selection of variables that approximate data available in EMRs *within the northeastern US*, not EMRs across other regions of the US or in other countries. Again, the variables selected here were intended to approximate data available within these records to demonstrate the potential of the conditional inference tree approach to identify high risk subgroups within large systems. As Streed and colleagues eloquently articulated, sexual orientation and gender identity (SOGI) data have not historically been collected in EMRs, despite the high relevance of this information for the provision of high-quality clinical care [80]. However, per Streed et al. [80], efforts to draw attention to this critical gap have led to data systems changes and, in 2016, to a requirement by the Health Resources and Service Administration's Bureau of Primary Health Care to collect and provide SOGI data in all federally funded community health centers. Hopefully, these changes will continue such that these data elements will be uniformly captured across EMR platforms. An additional substantial limitation of these analyses is the lifetime assessment of outcomes. Almost all psychosocial factors assessed are current, whereas outcomes are all lifetime assessment and/or age of onset. Given that most individuals have SI onsets in adolescence [81], limited conclusions can be drawn from these associations. Lastly, while the use of a national probability sample of TGD adults enhances generalizability, it is important to consider potential underreporting of suicidal thoughts and behaviors in this population. Underreporting of suicidality may be more common in this population due to healthcare stereotype threat and/or other forms of discrimination and marginalization [79,82,83].

In conclusion, we applied a novel data mining technique to isolate intersecting factors

associated with suicidal thoughts and previous attempts, as well as their respective ages of onset, in a national probability sample of TGD adults. Although there have been advances in transgender health care (e.g., insurance coverage for gender-affirming care, bias trainings for providers, the establishment of treatment and care standards) [84–87], there has also been a large movement across the US to restrict access to affirming care, which may contribute to increased risk for marginalization, discrimination, associated minority stress, and suicidality. If knowledge of these intersecting factors can be integrated into risk detection and other aspects of clinical care for TGD adults, healthcare systems and primary care settings are potential venues for data-enhanced, multi-level suicide risk reduction interventions that are affirming and comprehensive.

Abbreviations

EMR: electronic medical record
HST: healthcare stereotype threat
NB: gender non-binary
SI: suicidal ideation
STB: suicidal thoughts and behaviors
TGD: transgender and gender diverse
TM: transgender man
TW: transgender woman

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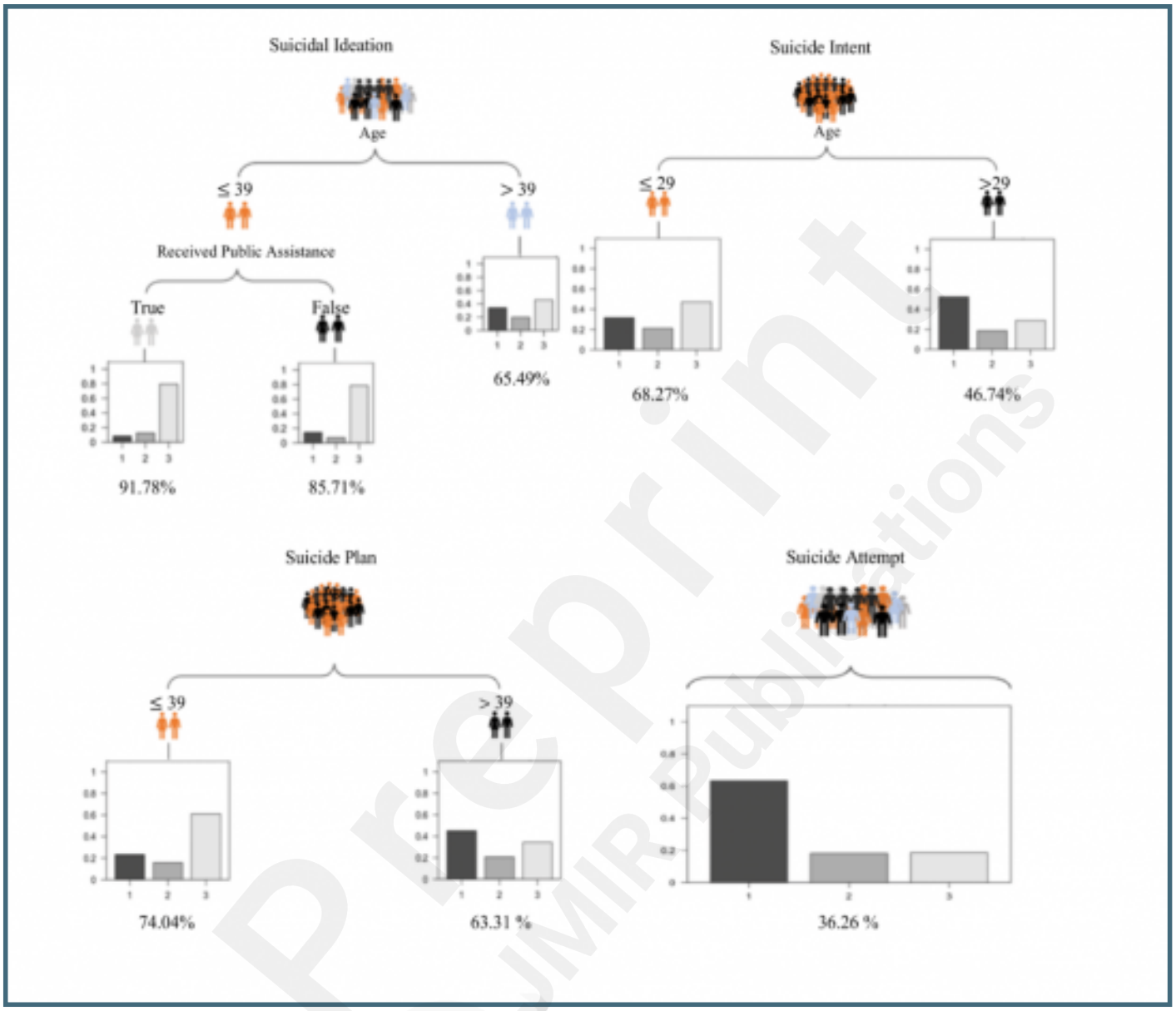
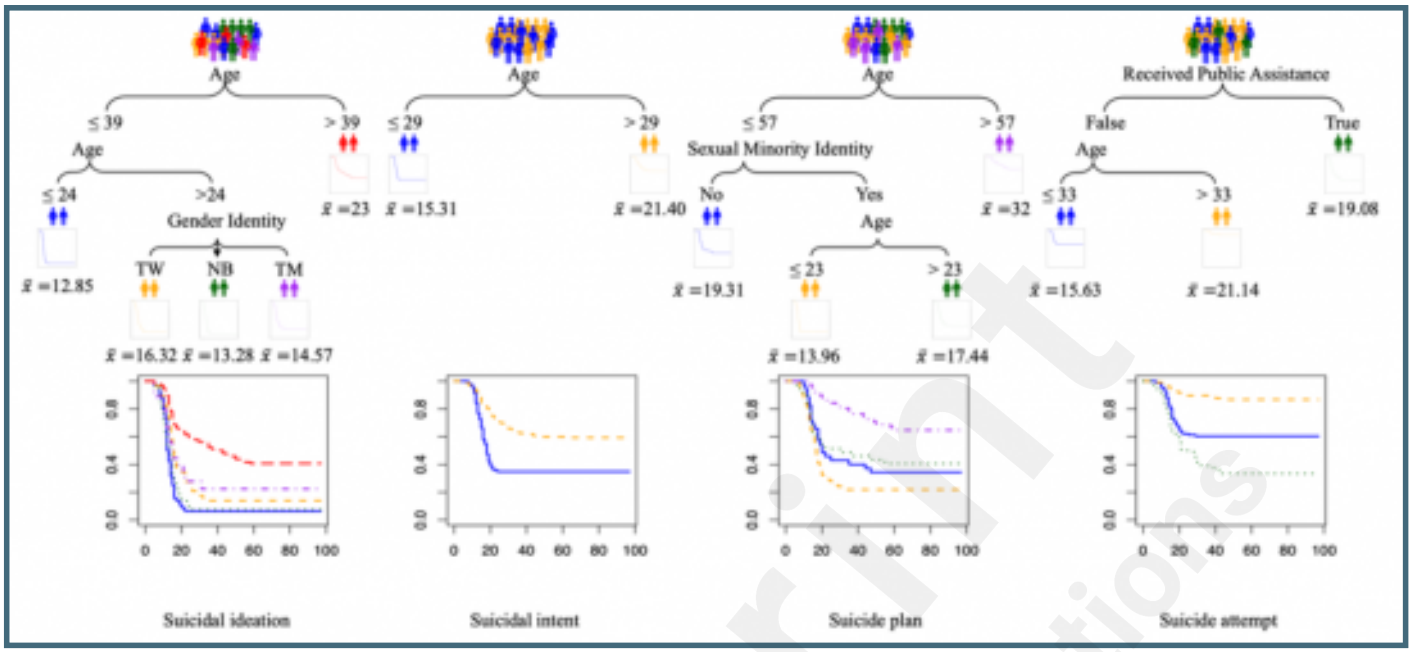
Supplementary Files

Figures

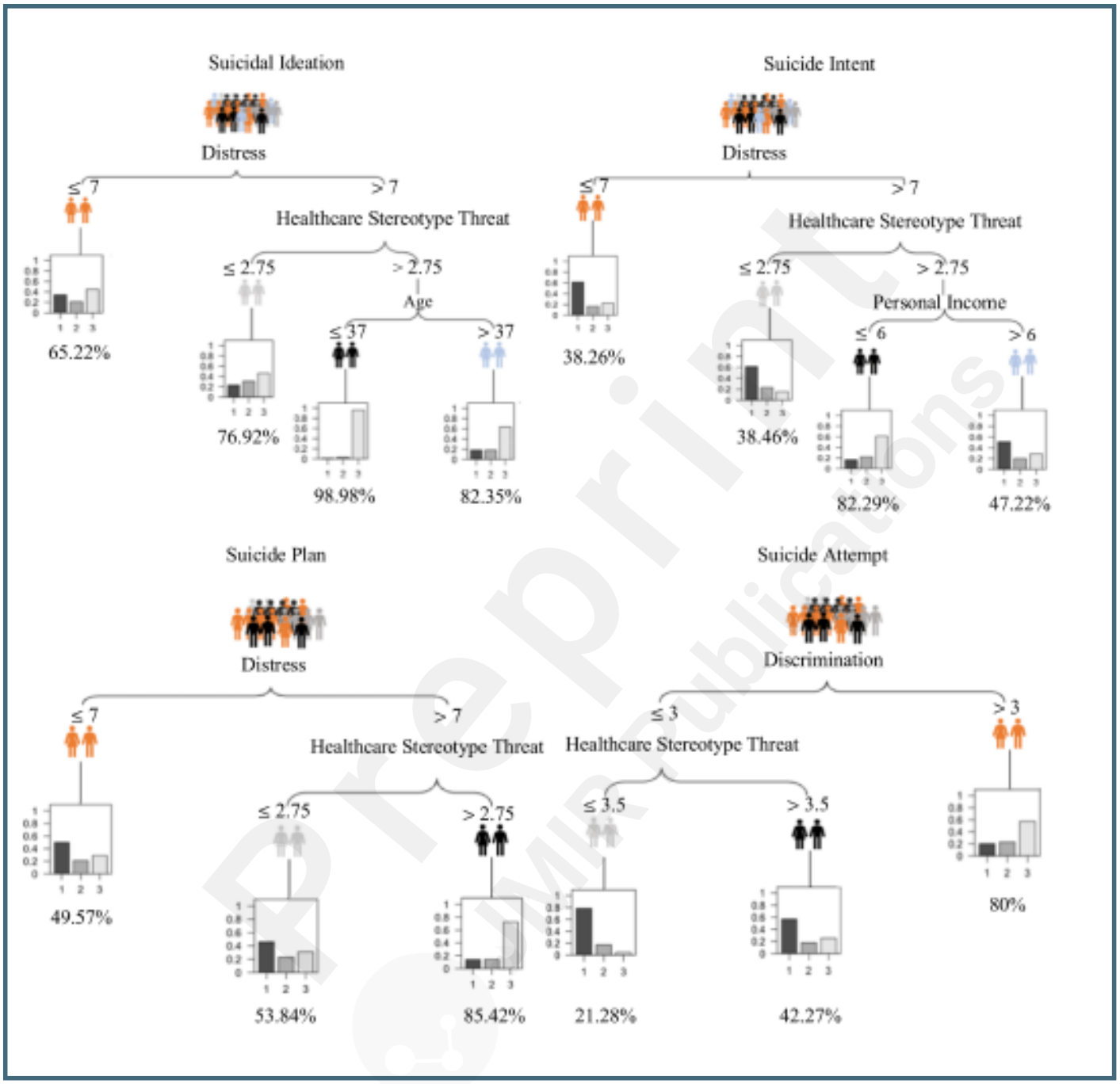
Tree diagrams for EMR-related variables predicting lifetime history of suicidal ideation, suicide intent, suicide plan, and suicide attempt.



Tree diagrams for EMR-related variables predicting age of onset for suicidal ideation, suicide intent, suicide plan, and suicide attempt.



Tree diagrams for the expanded set of variables predicting lifetime history of suicidal ideation, suicide intent, suicide plan, and suicide attempt.



Tree diagrams for the expanded set of variables predicting age of onset for suicidal ideation, suicide intent, suicide plan, and suicide attempt.