Changes in Suicidality Among Transgender Adolescents Following Hormone Therapy: An Extended Study

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Abstract

Objective: To examine changes in suicidality following hormone therapy (HT) among transgender and gender-diverse adolescents and young adults, extending prior findings using a larger clinical sample ($N = 432$) and a longer follow-up.

Study Design: A retrospective chart review was conducted at a multidisciplinary gender health clinic with 432 patients (mean follow-up = 679 days) completing the Ask Suicide-Screening Questions (ASQ) before and after treatment initiation. A repeated-measures ANCOVA assessed within-person changes in suicidality over time, adjusting for age at treatment and treatment duration.

Results: Suicidality significantly declined from pre-treatment to post-treatment, $F(1, 426) = 34.63$, $p < 0.001$, partial $\eta^2 = 0.075$. This effect was consistent across sex assigned at birth, age at treatment start, and treatment duration.

Conclusions: HT was associated with clinically meaningful reductions in suicidality over time, replicating prior findings and adding to the growing clinical evidence supporting the mental health benefits of timely access to HT in this population.

Keywords: gender dysphoria, transgender, gender-affirming hormones, adolescent, youth, testosterone, estrogen

Impact and Contribution

This study demonstrates a statistically and clinically significant decline in suicidality among transgender and gender-diverse youth after initiating hormone therapy, with effects consistent across demographic and treatment variables. Extending prior findings with a larger sample and longer follow-up, it provides timely, real-world clinical evidence to inform clinical guidelines and policy in adolescent gender healthcare.

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List of Abbreviations: GD: Gender Dysphoria; HT: Hormone Therapy; ASQ: Ask Suicide-Screening Questions

Introduction

Hormone therapy (HT) as a treatment for gender dysphoria (GD) involves the administration of testosterone, estrogen, and, when indicated, adjunctive medications (e.g., anti-androgens, progestins) to align secondary sex characteristics with gender embodiment goals. It is a standard treatment for GD, a condition defined as clinically significant distress or impairment caused by a mismatch between experienced gender and sex assigned at birth.[1,2] Transgender and gender-diverse youth face disproportionately high rates of depression, anxiety, and suicidality compared to their cisgender peers.[3] HT has been linked to improvements in a range of mental health outcomes, including GD, suicidality, eating disorders, and enhanced gender congruence and quality of life.[4–10] In several studies, following social support and treatment, psychosocial functioning returns to what would be expected for same-age peers.[3,8] However, the current evidence base is limited by small sample sizes, short follow-up, and the absence of control or comparison groups.

Although randomized controlled trials (RCTs) are considered among the most rigorous methods for evaluating treatment efficacy, they are ethically and practically challenging in the context of adolescent HT for GD.[11] Masking is not feasible, control group retention is poor when treatment is accessible elsewhere[12], and equipoise is contested (i.e., there is no longer genuine uncertainty among clinicians about whether treatment is beneficial), given the growing consensus around the benefits of HT for GD.[13] Many thus view it as unethical to withhold a medically indicated intervention from youth experiencing high distress. However, limited long-term outcome data also leave important questions unanswered, and no RCTs of adolescent HT have been conducted to date.[14] Even if such trials were approved, their methodological constraints would likely limit the insights they could offer. Comparative effectiveness and pragmatic trial designs may be more practical, focusing on delivery methods, dosing schedules, or developmental timing of HT for GD, addressing clinical questions without withholding care.[15]

In the absence of RCTs, observational studies provide important insights by examining outcomes in real-world clinical settings without assigning participants to treatment or control groups. In medicine, observational designs are commonly used when randomization is infeasible, and are often sufficient to inform clinical guidelines, especially when findings are consistent. Allen and colleagues (2019) used chart review data from 47 youth patients at a multidisciplinary gender clinic to examine suicidality outcomes following HT. While modest in scale and follow-up duration, it was the first clinical study to show reductions in suicidality following treatment among transgender youth. The current study replicates and extends that work at the same multidisciplinary clinic with a larger sample ($N = 432$), longer follow-up (mean = 679 vs. 349 days), and refined inclusion criteria. Consequently, it provides more robust estimates of how suicidality changes following initiation of HT and improves generalizability with a larger cohort. This information is increasingly needed by clinicians, policymakers, and courts evaluating HT for transgender youth.

Method

Participants

Participants were youth ages 12 to 20 years at baseline, treated for GD at a multidisciplinary pediatric gender specialty clinic in an urban Midwestern academic medical center. Inclusion criteria were receipt of HT for at least three months and suicidality data at both baseline and follow-up. Baseline was defined as the date of initial HT prescription. Follow-up was the most recent clinic visit while the patient remained on HT, which could occur in any hospital clinic, not exclusively the gender clinic. Power analysis indicated that a total sample size of 34

was sufficient to detect a medium effect ($f^2 = 0.25$) at $\alpha = 0.05$ with 80% power. The final sample included 432 youth (315 assigned female at birth, 117 assigned male at birth).

To minimize overlap with Allen et al. (2019), only patients who began HT in or after 2017 were included. Treatment initiation occurred between 2017 and 2024; dates reflect the full span of available records during this period. Notably, legislative bans in Missouri and Kansas restricted access to HT for youth starting in 2023 and 2025, respectively, thereby limiting what may have been a larger sample size.[16,17] Race and ethnicity were self-reported by participants or their guardians at intake and recorded in the electronic health record. Categories are listed alphabetically and reflect the institution's standardized demographic classifications. These data were collected to describe the clinical population and assess representativeness relative to regional demographics. Additional participant characteristics are presented in Table 1.

Procedure

The study was approved by the hospital's institutional review board. Data were collected as part of routine clinical care, following standards of treatment for GD from the World Professional Association of Transgender Health and the Endocrine Society.[1,2] The clinic's multidisciplinary team provided individualized treatment, which could include gonadotropin-releasing hormone agonists, used to temporarily suppress endogenous puberty, in addition to HT. As part of clinic and hospital policy, *Ask Suicide-Screening Questions* (ASQ) were administered at clinic visits across the health system, allowing suicidality data to be captured in multiple departments (e.g., at our gender clinic, developmental and behavioral health, endocrinology, etc.), while all participants remained patients of the same specialty gender clinic.[18] Patients typically completed a psychosocial intake assessment by a mental health professional, and if eligibility criteria were met, including a diagnosis of gender dysphoria and parental permission, they were referred to the multidisciplinary team for coordinated care. The team included medical providers, nurses, psychologists, social workers, and other staff. The clinic's model and procedures can be found in greater detail in prior publications.[4,19,20]

Measure

Suicidality was assessed using the four-item ASQ, which consists of yes/no responses. The ASQ items assess suicidal ideation and behavior, including wishes to be dead, feelings of being a burden, suicidal thoughts, and suicide attempts. The ASQ has demonstrated high sensitivity (97.6%) and moderate specificity (65.6%) for identifying young people at elevated suicide risk.[18] In some hospital clinics, the fourth item was adapted to assess recent suicide attempts ("*In the past few weeks, have you tried to kill yourself?*") rather than lifetime attempts ("*Have you ever tried to kill yourself?*"), to reduce redundancy across visits and better reflect changes in suicidality over time. Although this represents a minor deviation from the original validated ASQ wording, prior analyses have shown that the ASQ retains high sensitivity and specificity even when item 4 is excluded. Because the wording of item 4 sometimes varied across clinics, all positive endorsements were followed up on by a chart review to determine whether the reported attempt occurred recently (i.e., within the past few weeks of the visit). For analytic consistency, all item 4 responses were then coded as referring to a recent attempt, consistent with Allen et al. (2019). Item responses were coded as 0 ("no") or 1 ("yes"), yielding a total score ranging from 0 to 4, with higher scores indicating greater recent suicidal ideation. Internal consistency for the ASQ item set, as measured by Cronbach's alpha, was 0.76 at baseline and 0.79 at follow-up. The independent variable for the analysis was hormone therapy.

Analyses

A repeated-measures ANCOVA was conducted to evaluate change in suicidality, adjusting for treatment duration and including sex assigned at birth as a between-subjects factor.

This method is appropriate for comparing changes in a continuous outcome over time (e.g., baseline to follow-up) across discrete groups (e.g., sex assigned at birth) while adjusting for covariates. This allowed us to assess changes in suicidality while accounting for potential confounding factors. ASQ scores were positively skewed, particularly at follow-up, due to expected floor effects (i.e., clustering at the minimum score of 0). Both raw and square root-transformed scores were analyzed and yielded comparable results ($\Delta\eta^2 = 0.005$); transformed scores were used for all inferential tests (e.g., F-tests, η^2), while raw scores were retained for interpretability when presenting estimates, means, and standard deviations. Transformed ASQ scores met distributional assumptions at baseline (skew = 1.63, kurtosis = 0.99). Although skew and kurtosis remained elevated (skew = 3.50, kurtosis = 10.79) at follow-up, this was expected given treatment-related reductions in suicidality scores and likely reflects meaningful clinical improvement rather than random error. Given the large sample size, the bounded nature of the outcome (i.e., scores have a natural lower limit at zero), and ANCOVA's documented robustness to violations of normality,[21,22] these distributional properties were deemed acceptable. Outliers identified using boxplots (>1.5 box-lengths) were retained, as excluding them did not meaningfully alter the direction, significance, or interpretation of results. All other assumptions were met: Levene's test was non-significant at both baseline and follow-up ($p = 0.198$ and 0.070, respectively), indicating that error variances did not differ significantly across groups and the assumption of homogeneity of variance was met. No significant interactions were found between the covariate and groups, indicating no violation of the homogeneity of regression slopes assumption. Linearity was also satisfied.

For clarity and transparency in reporting, observed changes in ASQ scores from baseline to follow-up were used to categorize patients descriptively: those with decreased scores were considered to show reduced suicidality, whereas those with stable zero scores, unchanged non-zero scores, or increased scores were considered unchanged or elevated.

Results

Sample Characteristics

At baseline, ages ranged from 12.67 to 20.17 years ($M = 16.21$, $SD = 1.31$). Treatment duration ranged from 91 to 1899 days ($M = 679$, $SD = 410$, IQR = 364 to 938). Most patients ($n = 325$; 75%) received treatment for at least 364 days. Thirty patients had received pubertal suppression medication prior to HT. Seven patients discontinued HT: four due to a shift in gender identity (all of whom continued to identify as gender diverse), two for unknown reasons, and one due to concerns about hair loss. Reasons for discontinuation were determined by clinical chart review. Race and ethnicity were self-reported by participants or their guardians at intake. Participants identified as American Indian or Alaska Native (1 [0.2%]), Asian (2 [0.5%]), Black or African American (7 [1.6%]), Hispanic or Latino (15 [3.5%]), Multiracial (21 [4.9%]), Native Hawaiian or Other Pacific Islander (1 [0.2%]), and White (377 [87.3%]); eight participants (1.9%) declined or selected "Other" without further clarification.

Descriptive Outcomes

Of the 432 patients, 80 (18.5%) showed a decrease in ASQ scores from baseline to follow-up, indicating reduced suicidality. Most patients (n = 326; 75.5%) scored zero at both time points, suggesting a stable absence of suicidality across the study period. Six patients (1.4%) showed no change from a non-zero score, indicating chronic, yet stable suicidality. Twenty patients (4.6%) showed an increase in ASQ scores, possibly reflecting underlying mental health issues, environmental stressors, relief at baseline knowing they may be starting HT, or pre-existing trajectories of worsening suicidality that may have slowed but not reversed, rather than an adverse effect of HT. Additionally, at baseline, participants who had received pubertal

suppression prior to HT (n = 30) showed lower suicidality scores (M = 0.23, SD = 0.77) compared to the overall sample (M = 0.44, SD = 0.95). See Tables 2 and 3 for more information.

Model Results

Suicidality significantly decreased following HT, $F(1, 426) = 34.63$, $p < 0.001$, partial $\eta^2 = 0.075$, with adjusted means declining from 0.46 at baseline to 0.15 at follow-up (see Table 4). For interpretive context, partial η^2 values of 0.01, 0.06, and 0.14 are often considered small, medium, and large effect sizes, respectively. There was no significant interaction between HT and sex assigned at birth, $F(1, 426) = 0.104$, $p = 0.747$, partial $\eta^2 < 0.001$, suggesting that changes in suicidality were similar across sex groups. Neither age at the start of treatment, $F(1, 426) = 1.667$, $p = 0.197$, partial $\eta^2 = 0.004$, nor treatment duration, $F(1, 426) = 1.061$, $p = 0.304$, partial $\eta^2 = 0.002$, significantly predicted changes in suicidality. Because the ASQ total score is a bounded count variable with a strong floor effect, estimated marginal means may appear low even when a clinically meaningful change is present.

Discussion

Our findings are consistent with and extend those of Allen et al. (2019), demonstrating reductions in suicidal ideation following HT among transgender and gender-diverse youth [4]. Using a substantially larger sample and longer follow-up period, we observed a medium effect size (partial $\eta^2 = 0.075$), suggesting a stable and clinically meaningful association between HT and reduced suicidality.

Several factors may help explain these improvements. Hormonal changes are known to influence mood, affect regulation, and impulsivity, which may directly reduce suicide risk. Physical changes such as shifts in body shape, hair growth, or voice may also reduce distress associated with gender incongruence. For many, these changes bring a sense of relief and recognition, feeling more seen and more themselves. These changes can improve social experiences by lowering the likelihood of being misgendered and increasing acceptance and affirmation from providers, peers, and family.[3,6] Accessing HT may also serve as a validating milestone, reinforcing identity legitimacy. In our clinic, patients not only received HT for GD but were referred for therapy and medication management and were connected with affirming communities, all of which likely contributed to the observed improvements.

Baseline suicidality was already lower in patients with prior pubertal suppression, perhaps reflecting reduced distress from earlier intervention in preventing incongruent secondary sex characteristics; their lower scores limited the magnitude of observed change. Notably, treatment duration was not significantly associated with reductions in suicidality, suggesting that psychological benefits may have emerged early in the course of care. The lack of a clear dose-response pattern may reflect a threshold effect, where initial physiological, psychological, or social changes account for most of the improvement. These early effects may stem from rapid hormonal shifts, the relief of accessing affirming treatment, or concurrent engagement in therapy and community support at the time of HT initiation. While the overlapping nature of these factors limits our ability to isolate the effects of HT, the findings support efforts to reduce delays in access as a suicide prevention strategy for transgender and gender-diverse youth.

Although causal inference cannot be drawn from this observational design, our findings are consistent with a growing body of evidence linking HT with improved mental health outcomes.[1,4–10] Suicidality declined following HT, and this effect was consistent across sex assigned at birth. While most patients showed reduced or stable levels of suicidality, a small subset exhibited an increase in suicidal thoughts, consistent with patterns observed in other psychosocial and medical interventions, where a minority of patients may fail to improve or experience worsening. For example, a meta-analysis of psychological treatments for adolescent

depression found that approximately 6% of participants experienced clinically significant deterioration, a rate higher than but comparable to the 4.6% observed in our sample.[23] These cases do not necessarily indicate harm from HT. In some instances, distress may have already been worsening before treatment, with HT potentially slowing, but not reversing, that trajectory. Others may have experienced adjustment-related challenges following visible gender-related changes, such as increased scrutiny, family conflict, or shifting peer dynamics, reflecting greater minority stress in unsupportive environments rather than dissatisfaction with the effects of HT itself. This demonstrates the importance of ensuring preparation, planning, and affirming supports when initiating care. It is also possible that some patients became more comfortable disclosing suicidal thoughts over time, especially within affirming care settings. These varied explanations highlight the importance of viewing HT as one component within a broader system of support. As with other mental health interventions, including widely used treatments such as antidepressants, HT does not eliminate all risk. Good clinical practice requires that it be embedded within comprehensive, sustained mental health care capable of addressing co-occurring conditions and evolving psychosocial needs.

Although this study focused on suicidality, interpretation of findings should be informed by the broader clinical and ethical context in which HT is prescribed. Treatment decisions are shaped not only by psychological outcomes but also by physiological risks, access to care, and values-based considerations shared between patients, families, and healthcare providers. HT involves known medical risks. Testosterone may lead to erythrocytosis, lipid changes, or adverse androgenic effects,[1,24–27] while estrogen may increase thromboembolic risk or exacerbate other pre-existing conditions such as hyperprolactinemia, hypertriglyceridemia, and cholelithiasis.[25,28] Fertility considerations are also important, though emerging evidence suggests that fertility may be preserved or regained after discontinuation in some cases.[29] Both estrogen and testosterone have established safety profiles and are widely prescribed for a range of non-gender-related medical conditions.[30,31] Regret and detransition are uncommon, and when they occur, are often associated with inadequate evaluation or limited support during care.[32,33] Those beginning HT in adolescence appear to discontinue medication less frequently.[34] Further research on dosing and administration strategies may help determine if embodiment goals can be achieved with lower or more tailored hormone exposures. Such approaches may mitigate associated physiological risks while preserving the benefits of treatment.

Our sample was drawn from a multidisciplinary specialty clinic with experienced providers and access to comprehensive gender care services. Thus, these findings may not generalize to all youth prescribed HT for GD, particularly those in less resourced or less supportive settings. Similar to Allen et al. (2019), our sample remained largely White (83%) and therefore not representative of the broader population of diverse transgender and non-binary youth. A limitation of the study is that concurrent mental health treatment or affiliation with supportive communities were not systematically accounted for in the analyses. Both are known to improve well-being and are common interventions. In a clinic-based observation study, such as ours, it is not feasible to fully disentangle the effects of HT from those of concurrent supports. However, it is fair to conclude that these findings reflect outcomes within a real-world clinical context, while limiting inferences about HT in isolation.

In addition, because baseline suicidality was assessed at the point of HT initiation, the prevalence of suicidal ideation observed in our sample may not reflect that of the transgender and gender diverse youth more broadly. The timing and context of assessment (occurring as youth were beginning treatment, which may itself reduce hopelessness) may have temporarily lowered reports of suicidal ideation. As a result, the reductions observed in our study may also

underestimate the overall impact of treatment. These factors speak to the need for ongoing, methodologically rigorous research, especially longitudinal studies capable of capturing long-term medical and mental health outcomes. Research that examines longitudinal changes in parental support, minority stress, and gender congruence may clarify mechanisms underlying differences in suicidality outcomes across youth. At the same time, gender-affirming medical care is not unique in facing evidentiary gaps; limited or low-quality evidence is a pervasive feature across much of healthcare.[35] As with many areas of medicine, clinical and ethical decisions in gender care frequently occur under conditions of uncertainty, whether about caregiver support, treatment timing, or long-term outcomes. In such contexts, ethical practice involves prioritizing client autonomy and parental decision-making rights, selecting interventions with a reasonable expectation of benefit, and, when feasible, initiating care with more reversible options.[33,36–40]

Our findings, considered alongside similar results from other clinical contexts, lend support to the view that HT for GD can play a meaningful role in alleviating suicidality in transgender youth.[1,4–10] Building on our prior work, this study used a substantially larger sample, longer follow-up, and refined inclusion criteria to improve precision and generalizability. We observed a significant reduction in suicidal ideation after starting HT, with similar improvements across sex assigned at birth. While causal inferences remain limited by the observational design limits, the consistency of these findings strengthens the broader evidence base linking the initiation and progression of HT with reductions in suicidality in transgender and gender-diverse youth.

Ethics Approval: The study was approved by the hospital's institutional review board. Data were collected as part of routine clinical care. The institutional review board waived the requirement for informed consent due to the retrospective nature of the study.

Data Statement: Data from this study may be made available to qualified researchers for legitimate scientific purposes. Requests will be reviewed on a case-by-case basis to ensure compliance with any institutional policies.

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Table 1

Demographic Characteristics for Participants for the Cohort (N = 432), & each subgroup: AMAB (n = 117), AFAB (n = 315), & those who received blockers before HT (n = 30).

Characteristics	**All *N* (%)**	***AMAB n* (%)**	***AFAB n* (%)**	***GnRHa + HT n* (%)**
Age at baseline (yrs), M (SD)	16.21 (1.31)	16.56 (1.24)	16.08 (1.32)	15.75 (1.11)
Treatment duration (days), M (SD)	679 (410)	621 (378)	700 (419)	662 (418)
Race and Ethnicity				
American Indian or Alaska Native	1 (0.2)	0 (0)	1 (.3)	0 (0)
Asian	2 (0.5)	1 (0.9)	1 (0.3)	0 (0)
Black or African American	7 (1.6)	2 (1.7)	5 (1.6)	1 (3.3)
Hispanic or Latino	15 (3.5)	4 (3.4)	11 (3.5)	0 (0)
White	377 (87.3)	100 (85.5)	277 (87.9)	26 (86.7)
Multiracial	21 (4.9)	5 (4.3)	16 (5.1)	3 (10)
Native Hawaiian or Other Pacific Islander	1 (0.2)	1 (0.9)	0 (0)	0 (0)
Refused/Declined/Other	8 (1.9)	4 (3.4)	4 (1.3)	0 (0)

Note: GnRHa + HT refers to patients who had received GnRHa prior to being administered HT. Mean treatment duration of GnRHa prior to beginning HT for this group was 341 days (SD = 213; range: 72 to 833).

Table 2
Suicide Attempt Classification by Timepoint and ASQ Item Responses

Category	Baseline	Follow-Up
Total number of patients	**432**	**432**
All ASQ items negative	340 (78.7%)	400 (92.6%)
Endorsed one or more of ASQ items 1-3	92 (20.3%)	32 (7.4%)
Endorsed recent suicide attempt	13 (3%)	2 (0.46%)

Note: Suicide attempts were identified both by ASQ item 4 and confirmed through manual chart review for each patient. Lifetime suicide attempt history was: 62.5% none, 33.3% before treatment only, 2.8% during treatment only, and 1.4% both before and during treatment.

Table 3

Suicidality Score Means and Standard Deviations for the entire cohort and subgroups at Baseline and Follow-Up.

	Baseline				Follow-Up			
Scale	All *M* (*SD*)	AFAB *M* (*SD*)	AMAB *M* (*SD*)	GnRHa + HT *M* (*SD*)	All *M* (*SD*)	AFAB *M* (*SD*)	AMAB *M* (*SD*)	GnRHa + HT *M* (*SD*)
ASQ	0.440 (0.947)	0.451 (0.938)	0.410 (0.975)	0.233 (0.774)	0.160 (0.609)	0.178 (0.648)	0.111 (0.487)	0.10 (0.403)

Note. ASQ = Ask Suicide-Screening Questions; AFAB = Assigned Female at Birth; AMAB = Assigned Male at Birth. GnRHa = Gonadotropin-Releasing Hormone Agonist. GnRHa + HT refers to the subgroups of patients who had received GnRHa prior to being administered HT.

Table 4

Estimated Marginal Means and Standard Errors of the Analysis of Covariance for the Dependent Variable.

	Baseline			Follow-Up		
Scale	All *M* (*SE*)	AFAB *M* (*SE*)	AMAB *M* (*SE*)	All *M* (*SE*)	AFAB *M* (*SE*)	AMAB *M* (*SE*)
ASQ	0.456 (0.053)	0.446 (0.054)	0.466 (0.091)	0.146 (0.034)	0.175 (0.035)	0.117 (0.059)

Note. Results from the ANCOVA, covarying age of treatment initiation and duration of treatment. ASQ = Ask Suicide-Screening Questions; AFAB = Assigned Female at Birth; AMAB = Assigned Male at Birth.