

# Hormone Therapy, Suicidal Risk, and Transgender Youth in the U.S.\*

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## Abstract

This study uses the 2015 U.S. Transgender Survey to test how hormone replacement therapy (HRT) initiation affects the risk of attempting suicide among transgender individuals. We construct a retrospective panel of transgender people and employ a stacked event study design. Our results indicate that HRT initiation is associated with a statistically significant and substantially lower risk of suicide attempts. The ATT effect is a decrease of 5.7 percentage points in the risk of ever attempting suicide if HRT started between the ages of 14 and 17. This is a 14.4% reduction in the risk of attempting suicide relative to the pretreatment mean.

**Keywords:** Transgender, Hormone Therapy, Mental Health, Suicide

**JEL Codes:** I14, I18, I31, J15

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## I. Introduction

Transgender people in the U.S. experience considerable stigma, discrimination, and violence (Carpenter, Eppink and Gonzales, 2020). These problems contribute to gender minority stress and gender dysphoria,<sup>1</sup> key determinants of poor physical and mental health outcomes among transgender individuals (Meyer, 2003; Turban et al., 2022). People with gender dysphoria have much higher levels of depression, anxiety, and suicidality than people with gender congruence (Dhejne et al., 2016). According to the Endocrine Society, the primary treatment for gender dysphoria is gender-affirming care (GAC) which may entail puberty blockers, gender-affirming hormone therapy (hereafter hormone therapy or HRT), or gender-affirming surgery. GAC has been shown to reduce gender dysphoria and improve the health of transgender people (Mann, Campbell and Nguyen, 2022).

Despite the ability of GAC to improve the mental health of transgender people, several states have implemented policies that exclude GAC from health insurance coverage or instituted complete bans on the provision of GAC for transgender youth. Currently, 15 states have restricted or are planning to restrict minors' access to GAC, affecting more than a third of transgender youth aged 13-17 (Herman, Flores and O'Neill, 2022). These restrictions have contributed to ongoing debates regarding the age at which transgender individuals should be able to initiate GAC (Bazelon, 2022), thus highlighting the need for more empirical evidence on the efficacy of GAC, especially for adolescents.

By using the U.S. Transgender Survey (USTS) and recently developed estimation techniques, our study aims to contribute new evidence on the relationship between uptake of HRT and the outcomes of transgender youth. Our event study approach compares youth who started HRT (treated group) with those who initiated HRT a year later (control group). Results indicate that HRT is associated with a 5.7 percentage point reduction in the risk of attempting suicide, which amounts to a 14.4% decrease in the risk of attempting suicide relative to the pretreatment mean. Moreover, the effect is largest when HRT began at younger ages (i.e., 14-15). This study affirms the potential benefits of providing GAC access to transgender youth and highlights that policies which restrict access to GAC for transgender youth may have serious consequences.

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<sup>1</sup>Gender dysphoria refers to the distress caused by gender incongruence; i.e., distress that results from the mismatch between one's felt or self-identifying gender and their expressed gender, perceived gender, and/or sex assigned at birth (American Psychiatric Association, 2013).

## II. Data Description and Methodology

### II.A. United States Transgender Survey

The analysis uses the 2015 wave of the U.S. Transgender Survey.<sup>2</sup> The USTS – the largest survey of transgender people ever collected – has 27,715 respondents from all fifty states plus the District of Columbia, U.S. territories, and U.S. military bases abroad. The National Center for Transgender Equality conducted this online survey of transgender adults (18 and older) in the summer of 2015 as a follow-up to their inaugural 2008-09 National Transgender Discrimination Survey. It documents the lives and experiences of transgender individuals, with detailed information on a range of indicators including education, employment, race, family life, health status, marital status, and access to healthcare.

The USTS elicits the respondent’s age during significant life events, which we use to construct a retrospective panel. Respondents are asked “Have you ever had any of the health care listed below for your gender identity or gender transition?” If they respond yes to the option for “Hormone Treatment/HRT,” respondents are also asked the age at which they began HRT. We use this question to define the treatment variable, taking value 1 in the year that the individual began HRT and all years after, and zero in years prior to HRT initiation. Respondents are also asked “At any time in your life, did you try to kill yourself?” If the answer is yes, respondents are asked about the number of attempts as well as the age when the first attempt was made. We use this information to construct a dummy variable for *ever having attempted suicide* that equals zero for respondents who have never attempted suicide and equals one for respondents who have attempted suicide, post-attempt.

We note that the USTS is a nonrandom sample. A comparison of key demographic indicators in the USTS with the randomly sampled transgender adults in the Behavioral Risk Factor Surveillance System indicates that the USTS sample is younger, less racially diverse, and more affluent (Shannon, 2022). Given these demographic differences, if the treatment effects are heterogeneous, they may not reflect the overall transgender population.

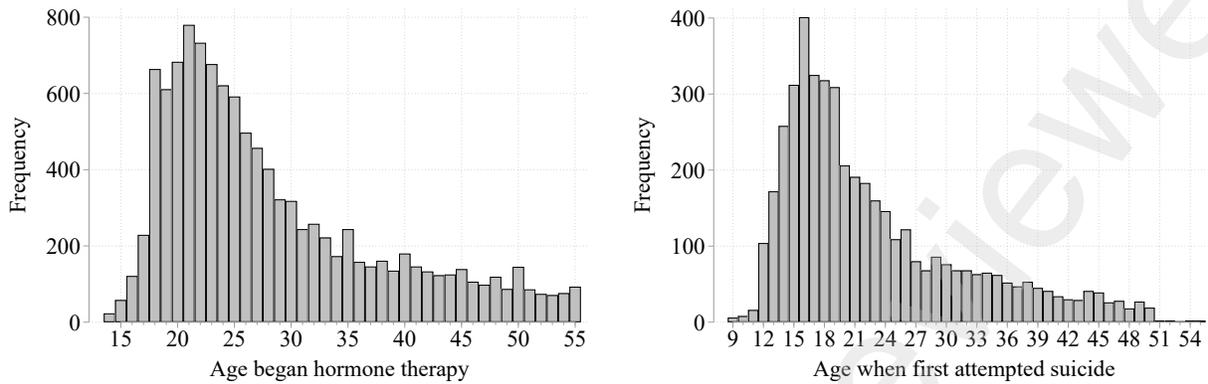
### II.B. Methodology

Since hormone therapy is only administered to those with persistent, well-documented gender dysphoria (Coleman et al., 2012), transgender people who started hormone therapy may be more prone to attempting suicide than those who do not. In contrast, those who had access to HRT might benefit from protective factors such as a supportive community or higher socioeconomic status. We tackle these selection issues by exploiting variation in

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<sup>2</sup>For a more detailed discussion of this data and its limitations, see (Campbell and Rodgers, 2022)).

Figure 1: Distribution of the Age of First Exposure to Hormone Therapy and Age when First Attempted Suicide



(a) Age when first began hormone therapy

(b) Age when first attempted suicide

*Notes:* The figures are histograms depicting the distribution of the age each respondent reports being when they were first treated with hormone therapy (panel a), and when they first attempted suicide (panel b), in our baseline analysis sample. Respondents who never attempted suicide during the sample are omitted in panel b.

the precise timing of hormone therapy. As shown in Figure 1a, the age at which transgender individuals first began hormone therapy has considerable variation. By using a stacked event study design to exploit this variation, we can construct credible control groups for each treated cohort by both using synthetic unit weights and by limiting the control group to those who successively underwent hormone therapy.

To ensure that appropriate comparisons are drawn, our final sample is a ‘stack’ of cohorts. A cohort is defined for every age of first exposure to HRT. For each cohort, the treated group is all respondents who report being the same age when they first started HRT. The corresponding control group includes all respondents who report beginning HRT when they were one year older than the treated group. Cohorts with less than fifty control units are dropped. Within each cohort, we estimate [Arkhangelsky et al. \(2021\)](#)’s synthetic unit weights to balance the trends in ever attempting suicide between treated and control individuals before exposure. We also align event time with the age of the treated group during first exposure, so event-time zero always denotes the first year of hormone therapy. Our final sample includes 42 cohorts, comprised of 11,330 treated individuals and 11,365 controls, totaling approximately 136,170 observations.

This approach ensures that within each cohort, the event study estimates are robust to both misspecification ([Arkhangelsky et al., 2021](#)) and to bias due to using already-treated units as controls ([Goodman-Bacon, 2021](#)). We efficiently aggregate the within-cohort estimates using a stacked approach with dynamic treatment effects. As is standard, we test for selection

bias by allowing the trends in outcome to deviate between treated and control individuals for five years prior to HRT. The baseline specification is:

$$Y_{c,i,t} = \mu + \sum_{k=-4}^0 \beta_k D_{k,c,i,t} + X'_{c,i,t} \gamma + \alpha_{c,i} + \delta_{c,t} + \zeta_{c,y} + \epsilon_{c,i,t} \quad (1)$$

where  $Y$  denotes an indicator for person  $i$  of cohort  $c$  ever attempting suicide as of event-time  $t$ ,  $D_k$  are leads and lags of an indicator variable for hormone therapy exposure,  $X$  is a vector of cohort-specific controls for socially transitioning and family support,<sup>3</sup>  $\alpha_{c,i}$  are cohort-specific individual fixed effects (which will account for all time invariant differences),  $\delta_{c,t}$  are cohort-event time fixed effects,  $\zeta_{c,y}$  are cohort-calendar year fixed effects, and  $\epsilon_{c,i,t}$  is the error term. The regression is weighted by the cohort-specific synthetic unit weights. Standard errors are clustered at the individual level, the level at which the treatment occurs. The main identifying assumption is parallel trends in the outcome. In Appendix Figure A1 we document evidence for this descriptively, while our event study results allow a more detailed visual test for pre-trends that accounts for covariates.

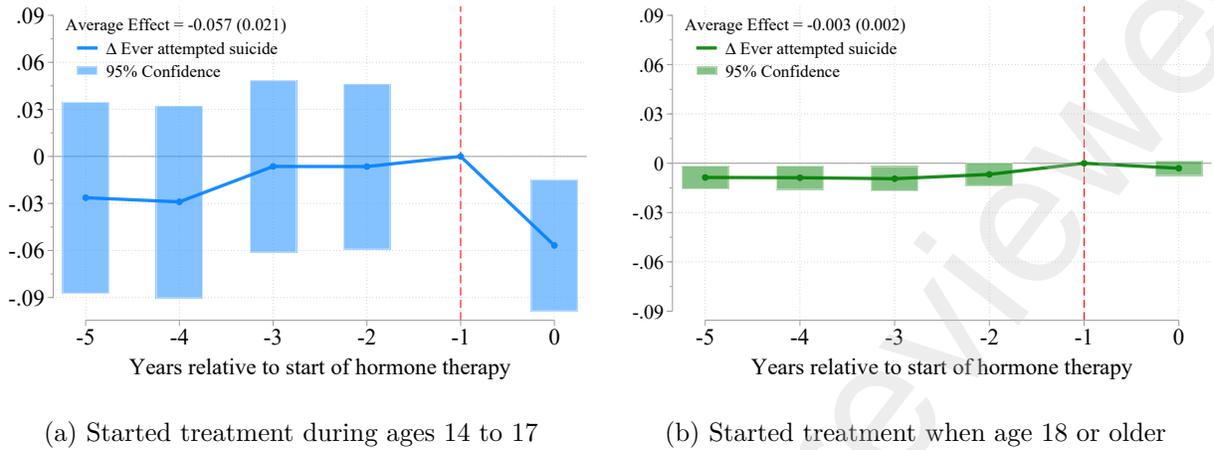
As noted, transgender individuals who undergo HRT are most likely different than those who do not. A comparison of pretreatment covariates indicates that there is no statistically significant imbalance in demographic and regional indicators, but transgender people who undergo HRT are more likely to have socially transitioned, experienced conversion therapy, and run away from home (Appendix Table A1). To further address this selection issue, our baseline regression specification controls for differences in social transitioning and level of family support (as proxied by subjection to conversion therapy and running away from home).

### III. Event Study Results

Our main results are depicted in Figure 2, which demonstrate that the initiation of HRT during ages 14-17 is associated with a statistically significant and meaningful reduction in the likelihood of attempting suicide (Panel A). In the five years prior to HRT, the coefficients are statistically indistinguishable from zero, suggesting a similar pre-trend in ever attempting suicide between transgender youth who began HRT (treated group) and those who initiate one year later (control group). However, the trends diverge during the first year of HRT, pointing to a 5.7 percentage point reduction in the risk of ever attempting suicide. This change is

<sup>3</sup>See Appendix Table A1 notes for a description of the control variables and the wording of the questions.

Figure 2: Evolution of the Impact of Hormone Therapy on the Risk of Attempting Suicide.



*Notes:* The figures show the estimates of the stacked event study model. The outcome is a dummy variable for ever attempting suicide (zero before the age of first attempting suicide and one for all years after first attempting suicide). All specifications include cohort-individual, cohort-age fixed, and cohort-calendar year effects as well as cohort-specific controls for socially transitioning and a supportive environment. The regressions are weighted by synthetic unit weights. The shaded area in each figure is the 95% confidence interval based on robust standard errors clustered by individual. The youth sample includes four cohorts, comprised of 431 treated individuals and 1072 control individuals, totaling 9,018 observations. The adult sample includes 38 cohorts, comprised of 10,899 treated individuals and 10,899 control individuals, totaling 127,152 observations. To put the coefficients into perspective, the share of treated individuals who had ever attempted suicide one year before starting hormone therapy is 39.44% in the youth sample and 38.36% in the adult sample.

equivalent to a 14.4% reduction given the baseline mean, implying that HRT substantially reduces suicidality of transgender youth. For transgender adults (aged 18 or older), we find no statistically significant relationship between HRT and suicidality (Panel B). The effect is largest when HRT began at ages 14-15 (Appendix Figure A2).

The key finding that age is a moderator in the association between HRT and transgender suicidality does not imply that HRT has no association with the suicidality of transgender adults. Our data does not allow for the identification of subsequent suicide attempts beyond the first attempt.<sup>4</sup> That is, the likelihood that a first suicide attempt precedes hormone therapy initiation declines across age cohorts. The association of HRT with a suicide attempt during adulthood may therefore be attenuated due to a higher likelihood of a prior attempt during adolescence, as demonstrated by the age profile of first suicide attempts in our data (Figure 1b). This profile indicates that the majority of first suicide attempts among transgender people occur during adolescence. Future work that can identify the effect of HRT on suicidality beyond the first suicide attempt will be particularly fruitful in further

<sup>4</sup>While respondents are asked the number of subsequent suicide attempts, the age of these subsequent attempts is not collected.

exploring the dynamic relationship between HRT and suicidality among transgender adults.

#### **IV. Summary and Discussion**

Our study used the 2015 U.S. Transgender Survey to test how HRT initiation affects the risk of attempting suicide among transgender individuals. We constructed a retrospective panel of transgender people and employed a stacked event study design to show that HRT initiation is associated with a statistically significant and substantially lower risk of suicide attempts. The ATT effect is a decrease of 5.7 percentage points in the risk of ever attempting suicide if HRT started between the ages of 14 and 17. This is a 14.4% reduction in the risk of attempting suicide relative to the pretreatment mean.

Our results are particularly relevant to policy makers and healthcare practitioners who need to be informed of the harmful consequences of public policies that restrict access to HRT and GAC for transgender youth. Such policies can substantially increase the risk of suicidal attempts and may hinder the mental health and wellbeing of transgender populations.

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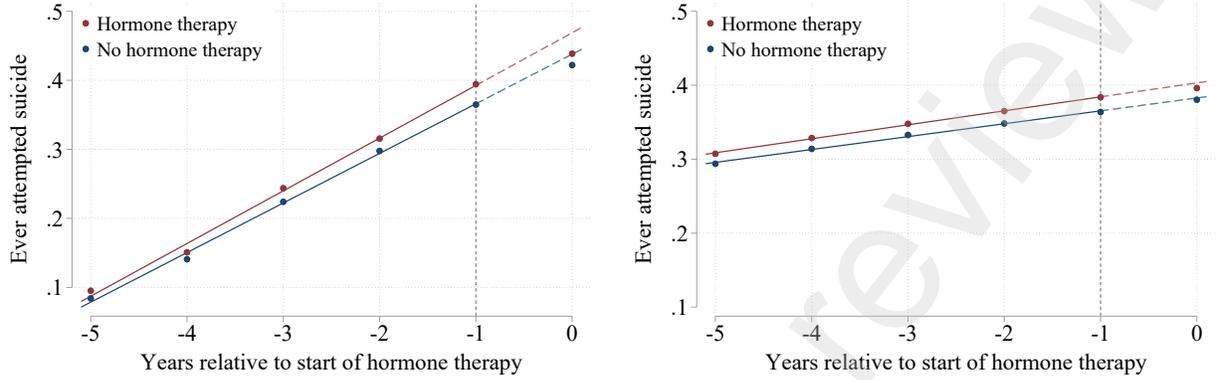
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## A. Appendix

Figure 3: Binned Scatter Plots of Ever Attempting Suicide by Hormone Therapy Status

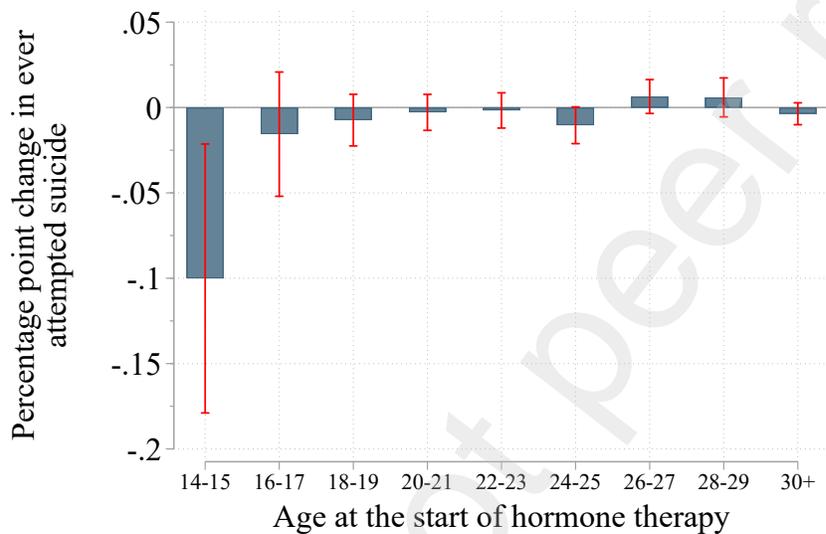


(a) Started treatment during ages 14 to 17

(b) Started treatment when age 18 or older

*Notes:* Figures 3a and 3b report binned scatters of ever attempted suicide, applying synthetic unit weights to the control group. Both figures also show the linear regression lines fit prior to hormone therapy, and the dashed line extends the fitted line into the post-treatment window. The control group includes people who are exposed to hormone therapy one year after the event window. The binned averages are found by averaging the outcome by treatment status and event time using our baseline stacked sample.

Figure 4: Heterogeneity by Age at Exposure in the Impact of Hormone Therapy on the Risk of Attempting Suicide.



*Notes:* This figure depicts the baseline event study estimate for the overall impact of hormone therapy on the probability of ever attempting suicide, subsetting by the cohort's age when the treated group was first exposed to hormone therapy. The y-axis is the percentage point change in the outcome, and the x-axis is the subset used for the estimate. The blue bars in each figure depict the group specific estimate and the red bands depict 95% confidence intervals based on robust standard errors clustered at the individual level. All regressions include cohort-individual and cohort-time fixed effects as well as cohort-specific controls for socially transitioning and a supportive environment, and are weighted by synthetic unit weights.

Table 1: Covariate Balance Prior to Hormone Therapy by Treatment Status and Sample

	Initiated HRT between ages 14 to 17			Initiated HRT when 18 or older		
	Treated	Control	Difference	Treated	Control	Difference
Ever felt gender different	.896	.837	.059*** (.008)	.953	.955	-.001 (.004)
Ever thought transgender	.723	.610	.113*** (.011)	.864	.856	.008 (.007)
Ever told others trans	.451	.316	.135*** (.013)	.554	.515	.040*** (.005)
Ever full time as identity	.187	.090	.097*** (.010)	.142	.078	.064*** (.003)
Ever ranaway from home	.045	.022	.022*** (.005)	.077	.072	.005 (.003)
Ever had conversion therapy	.100	.062	.037*** (.008)	.117	.111	.006 (.004)
White	.738	.728	.009 (.013)	.816	.846	-.030*** (.006)
Assigned male at birth	.309	.312	-.004 (.014)	.517	.629	-.112*** (.010)
<i>Region of birth</i>						
Northeast	.248	.236	.013 (.013)	.219	.233	-.014 (.009)
Midwest	.179	.175	.003 (.011)	.230	.254	-.024 (.014)
South	.204	.230	-.025 (.013)	.248	.226	.021** (.007)
West	.297	.284	.013 (.013)	.251	.233	.018* (.007)
Other	.000	.000	.000 (.000)	.000	.000	.000 (.000)
$F_{13, 10956}$	17.3***			93.1***		
People	431	1,072		10,899	10,092	

Notes: \* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$ . This table displays average pretreatment means by treatment status: people who had hormone therapy during the event window (treated) and people who started hormone therapy when one year older (control). Robust standard errors are clustered by individual and reported in parenthesis. The row F statistics reports the joint F-test for the difference in means. The control units are weighted by the synthetic unit weights. The following survey questions are used to measure the first six variables shown in Table A1, respectively: (1) “At about what age did you begin to feel that your gender was “different” from your assigned birth sex?” (2) “At about what age did you start to think you were trans (even if you did not know the word for it)?” (3) “At about what age did you first start to tell others that you were trans (even if you did not use that word)?” (4) “How old were you when you started to live full-time in a gender that is different from the one assigned to you at birth?” (5) “Did you ever run away from home because you are trans?” and (6) “Did any professional (such as a psychologist, counselor, religious advisor) try to make you identify only with your sex assigned at birth (in other words, try to stop you being trans)?” The first four variables measure differences in social transitioning, and the last two variables proxy family support.