Lives on the Line: The Effects of 988 Funding on Crisis Lines and Suicide Prevention

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An abstract of
a thesis submitted to the Faculty of Emory College of Arts and Sciences
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Abstract

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This paper examines the effects of funding towards crisis lines on their access, performance, and effectiveness in reducing suicides. Using the variation in the funding of the 988 Suicide and Crisis Lifeline, I create a quasi-experimental design employing a difference-in-differences empirical approach to study the causal effects of funding on call volume, answer rates, time to answer, and suicides. Using a novel dataset covering 50 states from July 2021 through December 2023, I find that passing funding increases call volume. In examining the effects of cumulative funding, I find that greater funding per capita increases call volume and reduces suicides. My findings highlight the importance of adequately funding crisis lines in order to increase their access and effectiveness.

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# Lives on the Line: The Effects of 988 Funding on Crisis Lines and Suicide Prevention

Jessie Zhu

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The United States is experiencing worsening mental health outcomes, especially in terms of suicides. From 2000 to 2018, suicide rates increased by 37%, with suicides being the 11th leading cause of death in the United States. In 2022 alone, 49,476 Americans died by suicide, and there were 1.6 million suicide attempts (AFSP 2024). Despite males only making up half the population, they commit suicide four times more than females and account for 80% of suicides (CDC 2024). Additionally, suicide as a leading cause of death varies across age groups. In 2021, suicide was one of the top three leading causes of death for ages 10 to 34 and was in the top 10 leading causes of death for ages 35 to 64 (CDC 2021). Despite these outcomes, 94% of adults surveyed in the United States believe that suicide can be prevented (AFSP 2024).

In the early 20th century, behavioral and mental health crises were handled by law enforcement or psychiatric institutionalization. As an alternative form of care, crisis lines began emerging around the middle of the 20th century, and in 1971, there were over 200 operating in the United States, driven largely by volunteers. In the 21st century, the Substance Abuse and Mental Health Services Administration (SAMHSA) became the main source of funding towards crisis lines (Draper and McKeon 2023).

Despite funding crisis lines for decades, the causal effects of funding towards crisis lines on their access, performance, and effectiveness in reducing suicides is not well-known. Understanding the causal effect of funding is important for policymaking, as resources are limited. Evaluating its impact ensures that funding is allocated efficiently and effectively. I aim to explore the effectiveness of state-level funding legislation towards suicide prevention lines on their access, performance, and effectiveness in reducing suicides. My research questions are as follows: Does funding towards suicide prevention lines increase the number of people who call to use their resources and services? Does this funding allow crisis lines to answer calls faster or more often? Lastly, are the number of suicides reduced by funding legislation?

I create a quasi-experimental design by using the variation in the funding of the 988 Suicide and Crisis Lifeline or 988 to explore these questions. In October of 2020, Congress passed the National Suicide Hotline Designation Act, which mandated that 988 must be available nationwide across all phone platforms on July 16, 2022. When that day came, 988 was launched, replacing the old National Suicide Prevention Lifeline with a phone number that was easier to dial and remember. This project was funded by SAMHSA and administered by Vibrant Emotional Health (Draper and McKeon 2023). While one of the goals of the federal 988 law was to increase the line's usage and access, it didn't provide funding to cover the costs of increased call demand. While SAMHSA continued to monetarily support each state's line partially, most of the funding responsibility for the 988 call centers fell onto state governments. From July 2021 through December 2023, only 28 states passed state-level funding legislation for their 988 centers (NAMI n.d. NAMI 2024; NASMHPD 2022; Stephenson 2022). The purpose of the funding was to support 988 access, performance, and improve its effectiveness in supporting suicidal callers. I combine novel monthly data from July 2021 through December 2023 at the state-level that includes 988 funding legislation (NAMI n.d. NAMI 2024; NASMHPD 2022; Stephenson 2022), 988 performance metrics

(Lifeline n.d.), suicide mortality (Health Statistics 2024), population demographics (U.S. Census Bureau 2020b; U.S. Census Bureau 2020a), federal grants (SAMHSA 2023), and macroeconomic data (U.S. Bureau of Labor Statistics 2024) for this research.

My main identification strategy is a staggered difference-in-differences design that uses the variation in funding legislation by state. My comparison groups are states that did not pass funding for 988 by the end of December 2023 and states that did pass funding. The outcomes of interest are state 988 center answer rates, call volume, average seconds to answer (ASA), and suicides.

I find that state-level funding legislation towards 988 increases call volume by 4.3%, a statistically significant result, but reduces suicides by an insignificant amount. However, when examining the effects of cumulative funding per capita, I find that one additional dollar of funding per capita leads to a 6.4% increase in call volume and a 0.5% decrease in suicides. That is, if a state moves from the 25th to 75th percentile in funding, it would experience an increase in call volume of 18.3% and a reduction in suicides of 1.5%. The effects of both the funding legislation and funding per capita on answer rates and ASA are less clear and insignificant. I also find spillover effects of funding in reducing overdose deaths. Overall, my findings suggest that state-level funding legislation towards 988 increases crisis line access, but in order to truly reduce suicides, the amount of funding must be adequate relative to the state's population.

My findings are robust. The event studies are insensitive to the use of Two-Way Fixed Effects, Callaway Sant' Anna (Callaway and Sant'Anna 2021), and Extended Two-Way Fixed Effects (Wooldridge 2021) estimating models. Additionally, after conducting a leave-one-out sensitivity test, I show that there are no outliers or states that majorly drive results. After conducting randomization inference, I show that there is no selection bias nor is the data skewed.

This research fills multiple knowledge gaps. To my knowledge, this is the first paper that seeks to examine the causal effect of funding towards crisis lines on their access, performance, and effectiveness in suicide reduction. Prior work has used pre-post policy implementation designs to produce state-level estimates of the annual increases in 988 call volume following implementation, the cost of these increases, and the extent to which state and federal funding were sufficient to meet call demand, but a causal relationship between funding and call volume hasn't been established (Purtle et al. 2023). I aim to explore the causal effect of 988 funding on call volume, and other outcomes such as answer rates, time to answer, and suicides. Additionally, research has been conducted in Japan on the relationship between funding towards suicide prevention programs and their effectiveness in reducing suicides. Nakano, Hasegawa, and Okada (2021), using multiple linear regression models, found that funding towards regional suicide prevention programs may be effective in reducing male suicide mortality but may be ineffective or even counterproductive for females and school-aged individuals (Nakano, Hasegawa, and Okada 2021). My research provides insight on the funding towards suicide prevention in the context of the United States and is focused on crisis lines.

Secondly, research on the relationship between call line use and suicide is limited. Prior research studied trends between crisis hotline call rates and suicide mortality in the United States from 2007 through 2020 by calculating state call rates to the Lifeline and annual state suicide mortality rates. The authors recommend identifying population-level drivers of patterns among states, incorporating factors such as state-specific policies and budgeting for mental health services (Kandula et al. 2023). My research extends upon this prior research and seeks to find the causal effect of state-level funding legislation on 988 call volume, and whether the change in call volume translates into a reduction of suicides.

Lastly, the relationship between crisis line usage and long-term outcomes is unclear. The existing evidence for the effectiveness of crisis lines has been weak and primarily focused on short-term outcomes, such as user distress and satisfaction (Zabelski et al. 2023; Hoffberg, Stearns-Yoder, and Brenner 2020). Prior research has found it difficult to focus on more dire, long-term outcomes, such as suicides, because robust methods of testing such as randomized control trials are deemed unethical. By employing a difference-in-differences method, my research avoids this problem while still contributing causal findings. My research aims to strengthen this literature on the long-term effectiveness of crisis lines and show policy-wise whether crisis lines should receive more funding.

# I Institutional Context

In the early 20th century, custodial approaches, such as law enforcement or institutionalization were the primary responses to behavioral and mental health crises. Crisis lines began emerging around the middle of the 20th century as an alternative form of care, with the first hotline established in Los Angeles in 1962. By 1971, there were over 200 operating in the United States. In 2001, SAMHSA created a national network of crisis lines, the National Suicide Prevention Lifeline or the Lifeline, that could be accessed through a single telephone number "1-800-273-TALK". It launched in 2005, with 109 crisis centers participating. Additionally, SAMHSA became the main source of funding for the Lifeline. After a few years, the Lifeline expanded its services, adding specialized support for Spanish-speaking individuals in 2006 and launching the Veterans Crisis Line (VCL) in 2007. The Lifeline then expanded its services to online chat services, with the VCL introducing a crisis chat service in 2009, and the main Lifeline following in 2013. In 2018, Senator Orrin Hatch and Representative Chris Stewart introduced the National Suicide Hotline Improvement Act, which garnered bipartisan support in Congress. This legislation directed the Federal Communications Commision (FCC), SAMHSA, and the Department of Veteran Affairs to assess the feasibility of a national three-digit suicide prevention number, which would be easier to remember and call. Following studies conducted by the three organizations, the FCC officially designated the three-digit code, 988, for the Lifeline. Subsequently, on July 16, 2022, the new 988 Suicide and Crisis Lifeline, or 988, launched with the goal of addressing suicide prevention, as well as a wide range of behavioral health crises, including substance use disorders and mental health emergencies (Draper and McKeon 2023).

When a person calls 988, they hear a greeting and are then instructed to press "1" if they are a Veteran or "2" if they would like to be connected to the Spanish language line. If neither option is selected, the caller is routed to a local 988 call center based on the area code of the caller. If the local 988 call center is unable to answer the call, the caller is then routed to a regional or national backup 988 center (Purtle et al. 2023).

# II Data

## A Sources

The data covers all 50 states on a monthly level from July 2021 through December 2023 and is sourced from multiple organizations and databases. Suicide mortality data is drawn from the Centers for Disease Control and Prevention's (CDC) National Center for Health Statistics via the National Vital Statistics System (Health Statistics 2024). Population estimates and demographic data come from the U.S. Census Bureau's American Community Survey, specifically the 2020 Decennial Census and the Demographic and Housing estimates (U.S. Census Bureau 2020b) (U.S. Census Bureau 2020a). State legislation related to 988 funding and implementation comes from the National Alliance on Mental Illness (NAMI), including the 988 Crisis Response State Legislation Map (NAMI n.d.) and the Trends in State Policy: 988 and Reimagining Crisis Response 2023 State Legislative Issue Brief (NAMI 2024). Additional information on 988 legislation is provided by the National Association of State Mental Health Program Directors (NASMHPD) reports such as the State-by-State Legislative Analysis of Funding (NASMHPD 2022) and the States' Experiences in Legislating 988 and Crisis Services Systems (Stephenson 2022). Federal grant data is sourced from SAMHSA for 2022 and 2023 (SAMHSA 2023). Additionally, unemployment data comes from the U.S. Bureau of Labor Statistics, retrieved from the Federal Resource of Economics

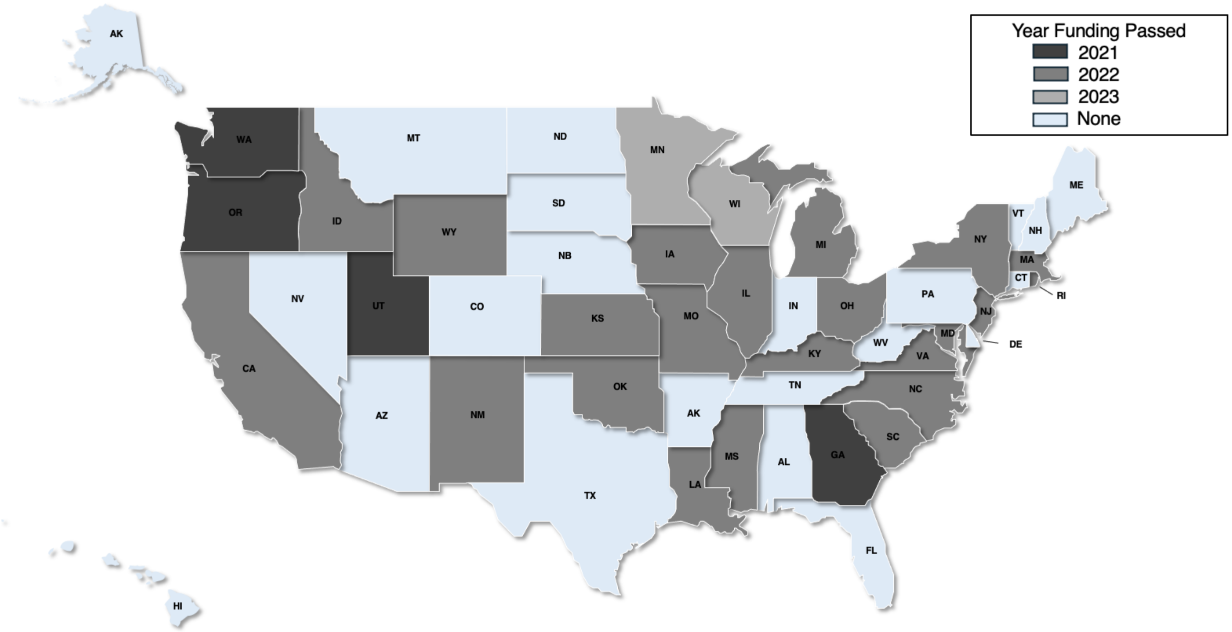



Figure 1: State-Level 988 Funding Legislation Rollout

Data (U.S. Bureau of Labor Statistics 2024). State-level monthly data on 988 performance metrics is obtained from the 988 website, maintained by Vibrant Emotional Health, the organization responsible for administering 988 (Lifeline n.d.). Overdose data comes from the CDC's State Unintentional Drug Overdose Reporting System (SUDORS 2025). The fully merged dataset starts in July 2021 and ends December 2023.

## B Outcomes

The outcomes of interest are answer rates, call volume, average seconds to answer, and suicides. Call volume is measured by the number of calls sent to a state's centers after the caller listens to the 988 greeting. All calls are sent to state centers first before being sent to a backup center if they are not answered. Answer rate is measured by the number of all calls answered in state divided by total call volume. The average speed of answer (ASA) is the average time a call takes to be answered after listening to the automated greeting. This is calculated by a state's average seconds to answer (Lifeline n.d.). I use call volume as an indicator of 988 access, while answer rates and ASA serve as indicators of performance. Suicides are identified using the International Classification of Diseases 10th Revision Codes: U03, X60-X84, and Y87.0. According to the CDC, statistics representing one through nine (1-9) persons are suppressed for confidentiality (Health Statistics 2024). Due to this suppression, there is missing suicide data for specific demographics that have a lower number of suicides. For purposes of this analysis, I replace missing suicide values with 0, though I show the validity of this imputation in a later robustness check. Additionally, I gather overdose data which comes from the CDC's State Unintentional Drug Overdose Reporting System (SUDORS 2025).

## C Treatment

The treatment variables are measured by the following: whether a state has passed funding for 988 by the end of 2023, the month and year in which funding was passed, if applicable, and the funding amount. First, I collected data on state-level 988 funding legislation through NAMI and NASMHPD. I referred to 4 sources: the NAMI 988 Crisis Response State Legislation Map (NAMI n.d.), NAMI Trends in State Policy: 988 and Reimagining Crisis Response 2023 State Legislative Issue Brief (NAMI 2024), NASMHPD State-by-State Legislative Analysis of Funding report (NASMHPD 2022), and NASMHPD States' Experiences in Legislating 988 and Crisis Services Systems report (Stephenson 2022). From these sources, I gathered the funding amounts and month year in which the funding became active. I assigned states to the treatment group if they passed legislation that funded 988 or state crisis lines and centers. For each state, I checked the publicly available bills or appropriations legislation to find the correct amount of funding. If the date the funding became active was explicitly mentioned, I used that date in my analysis, however, if it was not, I used the month after the legislation passed. If a state passed funding multiple times, I used the month of the first instance that legislation became active as the treatment date. I track the state funding amounts in my dataset cumulatively. That is, if a state passed funding multiple times, it has a value of 0 for the months before the legislation, and once funding is allocated, the amount remains constant, with additional funding added each time new legislation is passed.

# III Methods

I use a staggered difference-in-differences empirical approach to measure the impact of state-level 988 funding legislation on my outcomes of interest: answer rates, call volume, ASA, and suicides. My control group is states that did not pass 988 funding legislation by the end of 2023, and my treatment group is states that did. The onset of treatment is staggered, as many states passed legislation that became active at different months or years. The two preferred models are Two-Way Fixed Effects (TWFE) for answer rates and ASA and Poisson Pseudo-Maximum Liklihood (PPML) for call volume and suicides.

## A Estimating the Effects of State-Level Funding Legislation

TWFE provides a weighted average of the average treatment effect on the treated (ATT) across various groups based on treatment timing and allows for multiple time periods. It can also handle continuous treatment variables. The model is as follows:

$$Y_{st} = \beta_0 + \beta_1 \text{Legislation}_s \times \text{Post}_t + \delta_s + \sigma_t + \chi_{st} + \epsilon_{st} \quad (1)$$

$\beta_1$ is the parameter of interest. $\text{Legislation}_s$ is a binary variable that receives 0 if a state passed no funding legislation and 1 if a state did. $\text{Post}_t$ is a binary variable that receives 0 for all months before funding legislation was passed or if funding legislation was never passed, and 1 on the month funding was passed and all the following months. $\delta_s$ is state fixed effects, $\sigma_t$ is month year fixed effects, $\chi_{st}$ is a set of controls, and $\epsilon_{st}$ is the error term.

The set of controls include SAMHSA funding and monthly unemployment rates. I weigh the model by state population so that the estimates are representative of the ATT for an average individual. I also cluster standard errors by state to account for correlation within each state over time.

I also present event studies in the following form:

$$y_{st} = \beta_0 + \sum_k \phi_k \cdot \mathbf{1}[t - g = k] + \delta_s + \sigma_t + \epsilon_{st} \tag{2}$$

The summation term $\sum_k \phi_k$ represents event study effects that account for dynamic treatment effects over different time periods. $t$ represents the month, $g$ represents the month in which a state passed funding legislation, and $k$ represents relative months of $t$ from $g$. $\phi_k$ represents the ATT at relative months $k$. $\mathbf{1}[t-g=k]$ is an indicator function that takes the value of 1 at $k$ relative months away from the treatment date. $\delta_s$ is state fixed effects, $\sigma_t$ is month year fixed effects, and $\epsilon_{st}$ is the error term. I weigh the model by state population and cluster standard errors by state.

PPML is the preferred specification for call volume and suicides. It is a better fit for these variables compared to TWFE because it handles count variables by assuming a Poisson distribution, which TWFE does not. Additionally, PPML handles the existence of 0s in the dependent variable and is robust against heteroskedasticity. The coefficients are interpreted as semi-elasticities or percent change in the outcome (Correia, Guimarães, and Zylkin 2020). The estimating equation can be found in the Appendix as Equation 3.

In addition to using a TWFE approach for answer rates and ASA, I also include estimates using the Callaway and Sant'Anna Difference-in-Differences, or CSDID, (Callaway and Sant'Anna 2021) model which estimates ATTs by group by time by comparing treated units to appropriate comparison groups based on treatment timing. CSDID compares treated units to untreated units in the same relative months period and accounts for heterogeneous treatment effects. Additionally, I use an Extended Two-Way Fixed Effects, or eTWFE, (Wooldridge 2021) model. eTWFE is similar to TWFE, but allows for dynamic treatment effects and hetereogeneity across cohorts. eTWFE additionally accounts for unobserved factors that do not change over time but still might be correlated with the outcome variables.

## B Estimating the Effects of State-Level Cumulative Funding

Additionally, to examine the effects of cumulative funding allocated towards 988, I use a modified difference-in-differences empirical approach, where the treatment variable represents cumulative funding per capita and is continuous instead of binary. That is, instead of using $\text{Legislation}_s \times \text{Post}_t$ in the estimating equation, I use $\text{Funding}_s \times \text{Post}_t$, where $\text{Funding}_s$ is a continuous variable that represents cumulative funding per capita. The preferred specifications remain the same for each outcome variable, with TWFE for answer rates and ASA, and PPML for call volume and suicides. I weigh the model by state population and cluster standard errors by state.

# IV Results

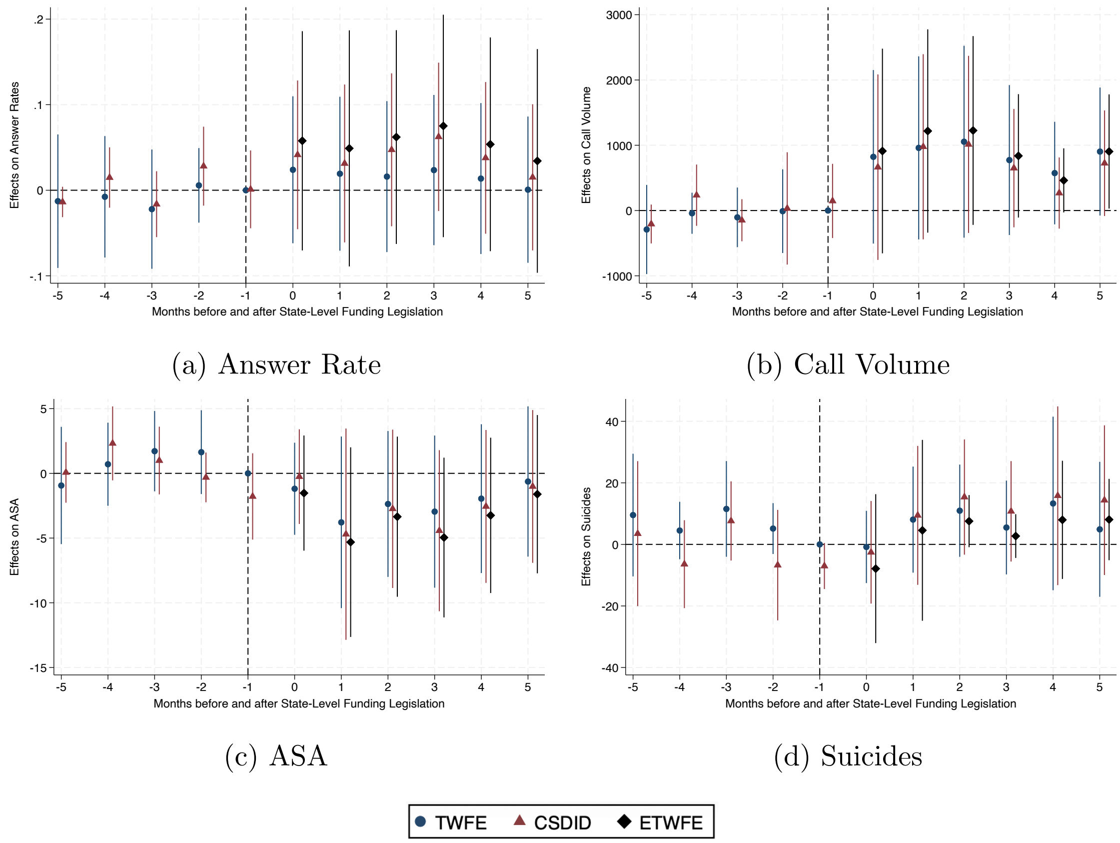
Descriptive statistics of both treated and untreated states pre-treatment are shown in Table 1. The average population and monthly unemployment rate of untreated states is lower compared to treated states. The average percentage of white individuals in untreated states is also higher than the percentage in treated states. The average suicides per month are relatively similar.

Table 1: Descriptive Statistics of Treated vs Untreated States

| | Untreated | | Treated | | T-Statistic |
|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | |
| **Population** | | | | | |
| Population | 6,013,447 | 7,394,277 | 7,796,720 | 7,478,783 | -1.97 |
| **Gender** | | | | | |
| Female | 0.50 | 0.01 | 0.50 | 0.01 | -2.28 |
| Male | 0.49 | 0.01 | 0.49 | 0.01 | 3.17 |
| **Race** | | | | | |
| White | 0.82 | 0.09 | 0.76 | 0.11 | 4.40 |
| Black | 0.09 | 0.07 | 0.14 | 0.11 | -4.00 |
| Non-white | 0.22 | 0.12 | 0.27 | 0.11 | -3.79 |
| **Age** | | | | | |
| Median Age | 39.23 | 2.78 | 38.13 | 1.73 | 4.04 |
| 0-14 | 0.18 | 0.02 | 0.19 | 0.01 | -2.79 |
| 15-34 | 0.26 | 0.02 | 0.27 | 0.01 | -3.11 |
| 35-54 | 0.24 | 0.01 | 0.25 | 0.01 | -2.24 |
| 55-74 | 0.23 | 0.02 | 0.22 | 0.02 | 4.23 |
| 75+ | 0.07 | 0.01 | 0.06 | 0.01 | 3.80 |
| **Other** | | | | | |
| Unemployment Rate | 4.01 | 1.17 | 4.34 | 1.15 | -2.34 |
| Suicides | 88 | 92.63 | 89 | 62.61 | -0.23 |

*Notes: This table presents descriptive statistics for both the untreated and treated group of states pre-treatment and is weighed by population. Demographics data comes from the U.S. Census Bureau ACS 5-Year Estimates. Estimates for race include race alone or in combination of one or more other races.*

To check that the identifying assumptions of parallel trends and no anticipation effects are met, I create event studies for the four outcome variables of interest: answer rates, call volume, ASA, and suicides, as displayed in Figure 2. Event studies also show dynamic treatment effects through leads and lags in time. All four event studies suggest there are no pre-existing trends that would influence the outcomes of the estimates and there are no noticeable anticipation effects. Additionally, estimates are consistent across the different estimating models used.




(a) Answer Rate

(b) Call Volume

(c) ASA

(d) Suicides

Figure 2: Event Studies

*Notes: This figure presents Two-Way Fixed Effects, Callaway Sant'Anna (Callaway and Sant'Anna 2021), and Extended Two-Way Fixed Effects (Wooldridge 2021) event study estimates for four outcome metrics: (a) Answer Rate, (b) Call Volume, (c) ASA, and (d) Suicides. The model is weighed by state population and standard errors are clustered by state. The vertical dashed line indicates one month before state-level funding legislation. Error bars represent 95% confidence intervals.*

# A Effects of State-Level Funding Legislation

The results estimating the impact of passing funding legislation are presented in Table 2. Columns 1, 3, 5, and 7 are estimates without controls, and columns 2, 4, 6, and 8 are estimates with controls. The preferred specifications of this paper are results that include controls, and their estimates are bolded for clarity. Again, the preferred specification for answer rates and ASA is TWFE, and the preferred specification for call volume and suicides is PPML. The legislation led to an increase in call volume by 4.3%, a statistically significant result.

However, the funding legislation reduces suicides by 0.9%, a near-zero and insignificant effect. The 95% confidence interval for the suicides estimate ranges from -3.0% to 1.2%, which lie around 0. The coefficient for answer rate is .023, indicating more calls are answered in states that passed funding legislation, though the result is not statistically significant. Additionally, the average seconds to answer decreased by 3.382, indicating that treated states answer the calls 3.382 seconds faster than untreated states, though the result is also insignificant.

The absence of changes in suicides implies that further investigation is needed into how funding legislation towards suicide prevention interventions translates into improved outcomes. While passing state-level funding legislation improves access for 988, it's not accomplishing one of the main purposes of 988, suicide prevention.

Table 2: Effects of Passing Funding Legislation

| | Answer Rate | | Call Volume | | ASA | | Suicides | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| TWFE | 0.020 | **0.023** | 1,257* | 1,140* | -3.260 | **-3.382** | -0.695 | -1.696 |
| | (0.066) | (0.067) | (716.685) | (659.127) | (2.932) | (3.188) | (1.430) | (1.578) |
| PPML | - | - | 4.308** | **4.268**** | - | - | -0.339 | **-0.886** |
| | | | (1.935) | (2.003) | | | (1.129) | (1.079) |
| CSDID | 0.007 | 0.020 | 1131* | 1078 | -3.018 | -2.813 | 5.868 | 6.301 |
| | (0.052) | (0.069) | (670.815) | (881.434) | (2.948) | ( 5.083) | (5.699) | (7.570) |
| ETWFE | 0.030 | 0.003 | 1348* | 1169*** | -3.722 | -3.941 | -1.057 | -1.796 |
| | (0.076) | (0.090) | (761.204) | (445.123) | (3.236) | (3.641) | (1.477) | (1.906) |
| Observations | 1,363 | 1,363 | 1,363 | 1,363 | 1,363 | 1,363 | 1,363 | 1,363 |
| Mean Dependent Variable | .768 | .768 | 3,713 | 3,713 | 29.162 | 29.162 | 88 | 88 |
| State FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Month Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Controls | No | Yes | No | Yes | No | Yes | No | Yes |

*Notes: This table presents Two-Way Fixed Effects, Callaway Sant'Anna (Callaway and Sant'Anna 2021), and Extended Two-Way Fixed Effects (Wooldridge 2021) estimates of the effect of state-level funding legislation on key outcomes: (1)-(2) Answer Rate, (3)-(4) Call Volume, (5)-(6) Time to Answer, and (7)-(8) Suicides. Poisson pseudo-maximum likelihood estimates are shown for Call Volume and Suicides. The coefficients for Poisson pseudo-maximum likelihood are transformed the following way:* $100 \times [e^{\beta} - 1]$. *Columns with "Yes" under Controls include additional covariates, which are SAMHSA funding and unemployment rate. Standard errors are reported in parentheses, and significance levels are denoted by *, **, and *** for p < 0.1, p < 0.05, and p < 0.01, respectively. The model is weighed by state population and standard errors are clustered by state. Mean Dependent Variable represents the mean of variables in the untreated states in the pre-period. The preferred specifications are bolded for clarity.*

To better understand the insignificant impact of state-level funding legislation on suicides, I examine heterogeneous effects to determine whether the impact is truly negligible or simply requires a more nuanced analysis. The results are depicted in Table 3. Similar to the findings in Table 2, the state-level funding legislation has a truly insignificant effect across suicides by gender, race, and age groups.

Table 3: Heterogeneous Effects on Suicides

| | Suicides | |
|---|---|---|
| | (1) | (2) |
| **Overall** | | |
| Total | -0.339 | -0.886 |
| | (1.129) | (1.079) |
| **Gender** | | |
| Female | 1.090 | 0.150 |
| | (2.199) | (2.388) |
| Male | -0.667 | -1.086 |
| | (0.778) | (0.817) |
| **Race** | | |
| White | 0.612 | 0.335 |
| | (0.941) | (0.865) |
| Black | 2.180 | -0.326 |
| | (7.239) | (6.966) |
| **Age** | | |
| 10-34 | -0.469 | -0.561 |
| | (1.559) | (1.558) |
| Observations | 1,363 | 1,363 |
| State FE | Yes | Yes |
| Month Year FE | Yes | Yes |
| Controls | No | Yes |

*Notes: This table presents Poisson pseudo-maximum likelihood estimates of gender, race, and age heterogeneous effects on suicides. The coefficients are transformed the following way:* $100 \times [e^{\beta} - 1]$*. Columns with "Yes" under Controls include additional covariates, which are SAMHSA funding and unemployment rate. Standard errors are reported in parentheses, and significance levels are denoted by *, **, and *** for* $p < 0.1$, $p < 0.05$, *and* $p < 0.01$*, respectively. The model is weighed by the state population for the specific demographic and standard errors are clustered by state. According to the CDC, statistics representing one through nine (1-9) persons are suppressed for confidentiality. These missing values are replaced with 0s in this analysis.*

## B Effects of State-Level Cumulative Funding

While the previous analyses examined the impact of passing funding, they did not account for differences in the amounts allocated. I further examine the effects of funding by analyzing the effects of cumulative funding per capita towards 988. The estimates are depicted in Table 4. For a one-dollar increase in funding per capita, call volume increases by 6.4%. Additionally, one additional dollar in funding per capita significantly decreases suicides by 0.5%. This finding at the intensive margin contrasts the previous result at the extensive margin. When considering only whether a state implemented funding, rather than the amount allocated, call volume increased by 4.3%, but there was no significant impact on suicide rates. In contrast, when accounting for cumulative funding per capita, both call volume increases and suicides decrease significantly. To put these estimates in context, the funding per capita varies greatly by state. I display the quartiles of funding in Table A of the Appendix. The 25th percentile is 0.780, the median is 1.378, and the 75th percentile is 3.640, which results in an interquartile range of 2.860. Translating this into realized results, if a state moves from 25th to 75th percentile in funding, they would experience an increase in call volume of 18.3% and a reduction in suicides by 1.5%. The results highlight the importance of financial investment in 988 and emphasize that funding should be proportionate to the state's population in order to be more effective in reducing suicides. Again, the effects on answer rates and ASA are insignificant.

Table 4: Effects of Cumulative Funding Amounts

| | Answer Rate | | Call Volume | | ASA | | Suicides | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| TWFE | 0.010 | **0.011** | 381 | 350 | 0.045 | **0.044** | -0.528 | -0.766** |
| | (0.009) | (0.010) | (442.877) | (429.405) | (0.882) | (0.902) | (0.411) | (0.349) |
| PPML | - | - | 6.061*** | **6.416*****| - | - | -0.346 | **-0.522**** |
| | | | (1.461) | (1.544) | | | (0.333) | (0.262) |
| Observations | 1,363 | 1,363 | 1,363 | 1,363 | 1,363 | 1,363 | 1,363 | 1,363 |
| Mean Dependent Variable | .768 | .768 | 3,713 | 3,713 | 29.162 | 29.162 | 88 | 88 |
| State FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Month Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Controls | No | Yes | No | Yes | No | Yes | No | Yes |

*Notes: This table presents Two-Way Fixed Effects estimates on the following outcomes: (1)-(2) Answer Rate, (3)-(4) Call Volume, (5)-(6) Time to Answer, and (7)-(8) Suicides. Poisson pseudo-maximum likelihood estimates are shown for Call Volume and Suicides. The coefficients for Poisson pseudo-maximum likelihood are transformed the following way:* $100 \times [e^{\beta} - 1]$. *Columns with "Yes" under Controls include additional covariates, which are SAMHSA funding and unemployment rate. Standard errors are reported in parentheses, and significance levels are denoted by *, **, and *** for p < 0.1, p < 0.05, and p < 0.01, respectively. The model is weighed by state population and standard errors are clustered by state. Mean Dependent Variable represents the mean of variables in the untreated states in the pre-period. The preferred specifications are bolded for clarity.*

## C Mechanisms

There are a couple of reasons that could drive my results. First, the larger increase in call volume, driven by additional funding per capita, could translate into more effective suicide prevention. This is due to the fact that funding first increases crisis line access before it ultimately affects suicide outcomes. When funding is spread too thin across a state's population, the effects may become diluted, which limits crisis line ability to significantly reduce suicides. However, when funding per capita is adequate, the increase in call volume more effectively reduces suicides.

Secondly, suicides can be impulsive and difficult to prevent right before occurrence, therefore, suicide prevention interventions face significant barriers. Suicide risk is often influenced by various long-term factors such as untreated mental health conditions, stress, chronic pain, and social struggles. Additionally, due to the existing mental health stigma, suicidal individuals may not seek out help, as they could be ashamed or unwilling to ask for help from a stranger on the other end of a call line. Therefore, there are many barriers that suicide prevention interventions need to overcome in order to truly make a difference. So, allocating enough funding per capita is essential in overcoming these barriers to suicide prevention.

Additionally, 988 is limited in the services it is allowed to provide. While 988 provides a trained counselor who can converse with the caller and listen to them while they are in distress, this is not comparable to the person receiving mental health treatment from a therapist or medical doctor. Also, ideally, suicidal callers would receive follow-up calls and have a continuum of care. While 988 has its own follow-up program, it requires all callers who experience suicidal ideation to consent to a follow-up which would be conducted over the phone (Lifeline 2023). While this is a step in the right direction to increase the continuum of care for suicide prevention and treatment, it is probable that many callers would opt out of this service. Additionally, resources and services can only be shared in the limited time of one phone call. Therefore, higher funding per capita likely means more staff and training, outreach, and mental health resources per caller, leading to better service delivery within the small time frame where the call can make a difference.

The effects on answer rates and ASA are unclear and insignificant when looking at both the extensive margin and intensive margin. It is possible that the surge in call volume may have overwhelmed these call centers' capacities. For example, creating marketing materials and advertising campaigns for 988 could have been a quicker process than improving call center infrastructure. Therefore, there could be a lag in improvements due to resource constraints. Additionally, it is possible that there was enough funding to improve marketing and advertising for 988, however, there was not enough funding to truly improve operational and performance efficiencies.

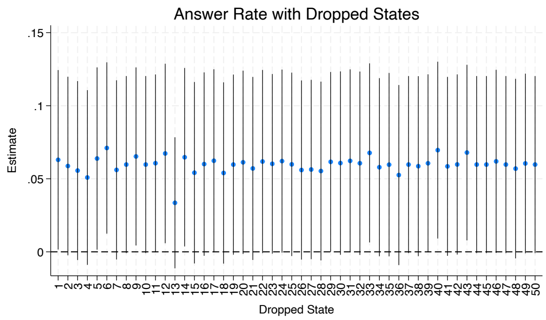
Another mechanism is the possibility of free-rider effects. Currently, if a call to 988 is not answered within state, it gets routed to a national backup center. Therefore, it's possible that many states wouldn't prioritize increasing their answer rates or decreasing their time to answer because they know that the call will eventually reach the national backup center. For example, states that did pass funding may have invested most of it into another portion of the line, such as training existing workers or increasing 988 marketing.

## D Spillover Effects

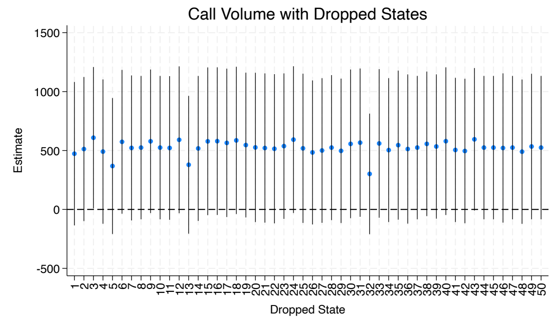
Additionally, I hypothesize that funding towards 988 may have spillover effects towards other mental health outcomes. According to SAMHSA, in addition to suicide prevention, 988 can be used for those who need support for a suicide, mental health, and/or substance use crisis. Some examples include problems with drug or alcohol use, emotional distress, anxiety, depression, mental illness, loneliness, trauma, bullying, stress, relationship troubles, and just needing someone to talk with (SAMHSA n.d.). I find that passing state-level funding legislation towards 988 reduces overdose deaths by 5.3%, which is displayed in Table B in the Appendix. This could be due to an overlap between populations at-risk for suicide and populations at-risk for overdosing. Therefore, solely looking at suicide outcomes underestimates the true effect of funding legislation towards 988, as funding towards crisis lines may benefit other mental health outcomes too.

# V Robustness Checks

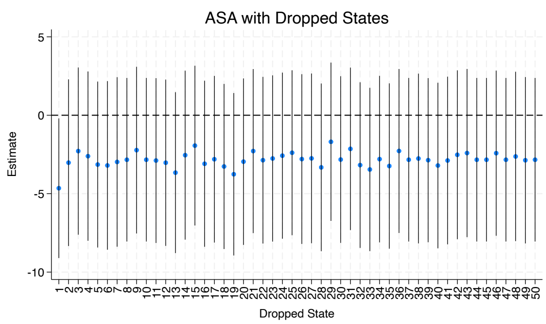
I then conduct two robustness checks for my four outcome variables. Figure 3 displays a robustness check where I estimate a Callaway Sant'Anna difference-in-differences model for my outcome variables in a leave-one-out sensitivity test. Figure A in the Appendix is a legend that displays the numbers representing each state shown in Figure 3. The estimates remain level, which indicates that the results are robust and are not driven by outliers.



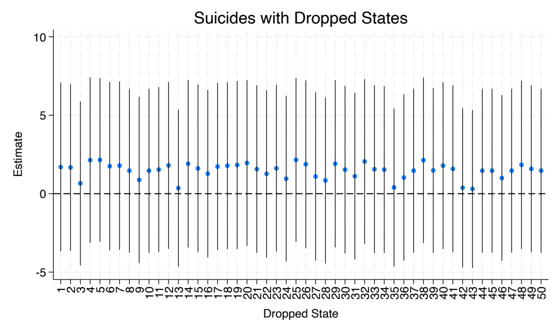

(a) Answer Rate




(b) Call Volume




(c) ASA

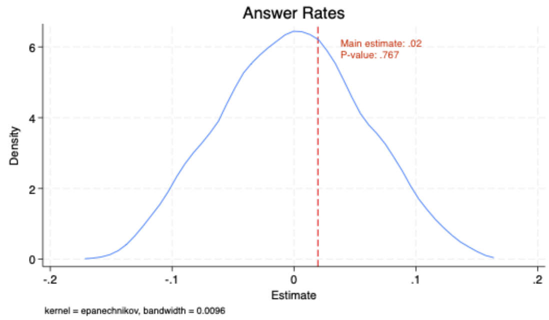



(d) Suicides

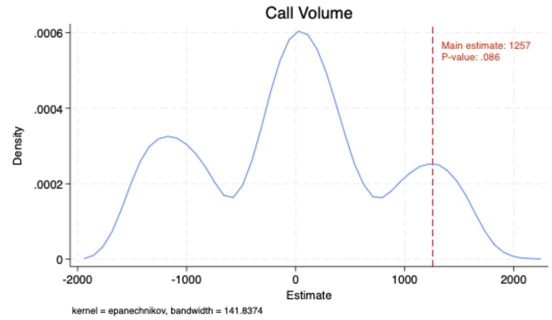
Figure 3: Leave-One-Out Sensitivity Analysis

*Notes: This figure presents a leave-one-out sensitivity analysis using the Callaway Sant' Anna Difference-in-Differences (Callaway and Sant'Anna 2021) estimating model on the impact of state-level funding legislation on the four outcome metrics: (a) Answer Rate, (b) Call Volume, (c) ASA, and (d) Suicides. The model is weighed by state population and standard errors are clustered by state. Covariates are excluded. Error bars represent 95% confidence intervals. A legend with dropped states and their respective numbers can be found in Figure A in the Appendix.*

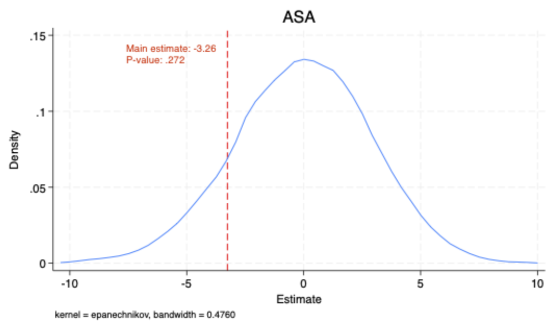
In Figure 4, I conduct randomization inference for my four outcome variables. I randomize which 28 states become ever treated, and then I randomize their cutoff dates. Then, I estimate the model at the extensive margin and save the estimate. I repeat this process at 5,000 repetitions. All distributions for my outcome variables are centered at 0 which indicates my data isn't inherently skewed in one direction or another. Additionally, the average placebo estimates are symmetrical, further supporting the assumption of no selection bias. Interestingly, call volume is trimodal which likely indicates there are heterogeneous effects across states. Additionally, I conduct randomization inference for my four outcome variables at the intensive margin, and I display the results in Figure B in the Appendix. The distributions are also centered at 0, indicating robustness at the intensive margin.



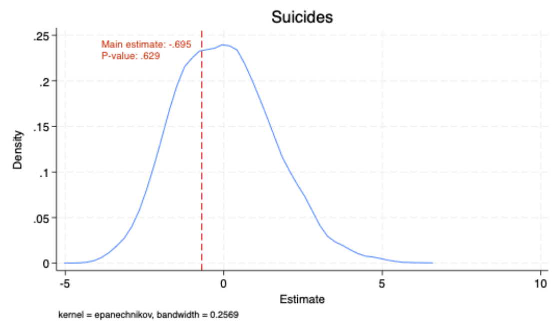

(a) Answer Rate




(b) Call Volume




(c) ASA




(d) Suicides

Figure 4: Randomization Inference

*Notes: This figure presents Two-Way Fixed Effects estimates at the extensive margin using randomization inference for four outcome metrics: (a) Answer Rate, (b) Call Volume, (c) ASA, and (d) Suicides at 5,000 repetitions. Covariates are excluded. The model is weighed by state population and standard errors are clustered by state.*

Since the CDC suppresses suicide counts under 10, I replaced the suppressed values with 0s. There were no suppressed values in the main results, but they existed in the heterogeneous effects on suicides results. I ran an additional robustness check to see whether this imputation technique significantly affects results. In the Appendix, Table C displays an analysis where I replaced all 0s in the suicide data with 10, the minimum number of suicides to be recorded. I used Table 3 as the table to be displayed with the new estimates because it includes suicides across multiple demographics, some of which had missing suicides due to the suppression in the original CDC data. Across estimations with and without controls, the direction, magnitude, and significance of the estimates remain similar. This indicates that the imputation technique of replacing missing suicides with 0 does not significantly alter results.

# VI Conclusion

I explore the effects of state-level funding towards crisis lines on their answer rates, call volume, ASA, and suicides. I find that passing funding legislation has a significant effect on increasing call volume, but has an insignificant effect on answer rates, ASA, and suicides. When examining effects of cumulative funding per capita, I find that one additional dollar per capita has a significant effect on increasing call volume and reducing suicides, but similarly has insignificant effects on answer rates and ASA. I also find that funding legislation reduces overdose deaths, indicating positive spillover effects.

The results indicate that passing funding legislation at the extensive margin may improve 988 access, but doesn't necessarily translate into reducing suicides. In order to be more effective at reducing suicides, the amount of funding per capita needs to be adequate. In terms of mechanisms, the larger increase in call volume, driven by additional funding per capita, could translate into more effective suicide prevention. Additionally, there are significant barriers to suicide prevention, therefore allocating greater funding per capita is essential in overcoming these barriers. Another mechanism is that 988 is limited in the services it can provide and is restrained to the time frame of one phone call, so more funding is necessary in order to improve the service delivery within each call.

The results for answer rates and ASA indicate that the funding does not necessarily improve 988 operations and performance. In terms of mechanisms, it is possible that the increased call volume overwhelms the centers, so their answer rates and time to answer don't improve. Another possibility is the existence of free-rider effects with states not prioritizing increasing answer rates or decreasing time to answer, since there is a national backup center that picks up calls that do not get answered in-state.

In the future, more research on this topic should focus on more mental health outcomes, such as emergency room visits due to self-harm, suicide threats, enrollment in mental health treatment, depression, and anxiety. Additionally, as of January 2025, 10 states have passed a 988 telecom fee (NAMI n.d.). I recommend studying the effects of this usage fee on the same outcomes I used in this paper to understand if a continuous fee is more or less effective than state-level legislation that passes large amounts of funding. As 988 continues to grow, its care continuum will likely also grow within states. Many states have built or passed funding for mobile response teams and additional crisis centers. In the future, funding towards these initiatives should also be examined in terms of their effectiveness in reducing suicides.

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# VII Appendix

$$Y_{st} = \exp[\beta_0 + \beta_1 \text{Legislation}_s \times \text{Post}_t + \delta_s + \sigma_t + \chi_{st}]\epsilon_{st} \tag{3}$$

$\beta_1$ is the parameter of interest. $\text{Legislation}_s$ is a binary variable that receives 0 if a state passed no funding legislation and 1 if a state did. $\text{Post}_t$ is a binary variable that receives 0 for all months before funding legislation was passed or if funding legislation was never passed, and 1 on the month funding was passed and all the following months. $\delta_s$ is state fixed effects, $\sigma_t$ is month fixed effects, $\chi_{st}$ is a set of controls, and $\epsilon_{st}$ is the error term. The set of controls include SAMHSA funding and monthly unemployment rates.

Table A: Quartiles of Funding per Capita

| Quartile | Funding per Capita |
|---|---|
| 25th | 0.780 |
| 50th | 1.378 |
| 75th | 3.640 |
| IQR | 2.860 |

*Notes: This table presents the quartiles of funding per capita in the states that passed funding. IQR is interquartile range which represents the difference between the 75th and 25th percentile.*

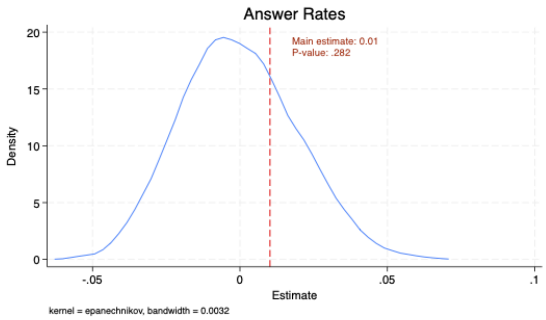
Table B: Effects of Passing Funding Legislation on Overdoses

| | Overdoses | |
|---|---|---|
| | (1) | (2) |
| Legislation × Post | -5.233 | **-5.274*** |
| | (3.503) | (2.669) |
| Observations | 939 | 939 |
| Mean Dependent Variable | 142 | 142 |
| State FE | Yes | Yes |
| Month Year FE | Yes | Yes |
| Controls | No | Yes |

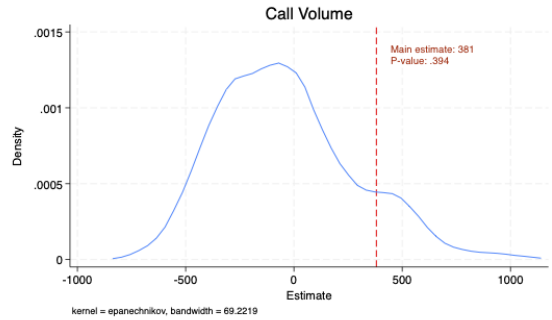
*Notes: This table presents Poisson pseudo-maximum likelihood estimates of state-level funding legislation effects on overdoses. The coefficients for Poisson pseudo-maximum likelihood are transformed the following way:* $100 \times [e^{\beta} - 1]$. *Columns with "Yes" under Controls include additional covariates, which are SAMHSA funding and unemployment rate. Standard errors are reported in parentheses, and significance levels are denoted by *, **, and *** for p < 0.1, p < 0.05, and p < 0.01, respectively. The model is weighed by state population and standard errors are clustered by state.*

| Number | State |
|---|---|
| 1 | Alabama |
| 2 | Alaska |
| 3 | Arizona |
| 4 | Arkansas |
| 5 | California |
| 6 | Colorado |
| 7 | Connecticut |
| 8 | Delaware |
| 9 | Florida |
| 10 | Georgia |
| 11 | Hawaii |
| 12 | Idaho |
| 13 | Illinois |
| 14 | Indiana |
| 15 | Iowa |
| 16 | Kansas |
| 17 | Kentucky |
| 18 | Louisiana |
| 19 | Maine |
| 20 | Maryland |
| 21 | Massachusetts |
| 22 | Michigan |
| 23 | Minnesota |
| 24 | Mississippi |
| 25 | Missouri |
| 26 | Montana |
| 27 | Nebraska |
| 28 | Nevada |
| 29 | New Hampshire |
| 30 | New Jersey |
| 31 | New Mexico |
| 32 | New York |
| 33 | North Carolina |
| 34 | North Dakota |
| 35 | Ohio |
| 36 | Oklahoma |
| 37 | Oregon |
| 38 | Pennsylvania |
| 39 | Rhode Island |
| 40 | South Carolina |
| 41 | South Dakota |
| 42 | Tennessee |
| 43 | Texas |
| 44 | Utah |
| 45 | Vermont |
| 46 | Virginia |
| 47 | Washington |
| 48 | West Virginia |
| 49 | Wisconsin |
| 50 | Wyoming |

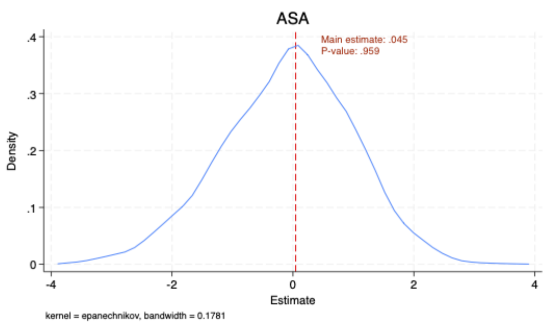
Figure A: Figure 3 Legend



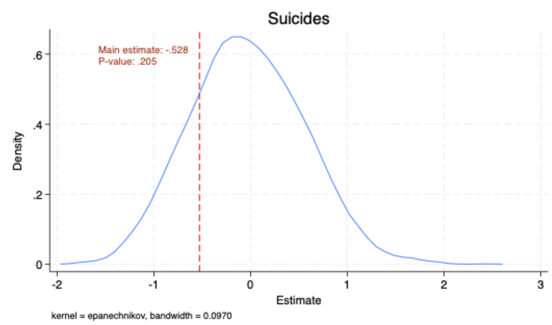

(a) Answer Rate




(b) Call Volume




(c) ASA




(d) Suicides

Figure B: Randomization Inference

*Notes: This figure presents Two-Way Fixed Effects estimates at the intensive margin using randomization inference for four outcome metrics: (a) Answer Rate, (b) Call Volume, (c) ASA, and (d) Suicides at 5,000 repetitions. Covariates are excluded. The model is weighed by state population and standard errors are clustered by state.*

Table C: Robustness of Imputing Missing Suicide Data

| Missing Suicides Imputation | Replaced with 0 | | Replaced with 10 | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| **Overall** | | | | |
| Total | -0.339 | -0.886 | -0.339 | -0.886 |
| | (1.129) | (1.079) | (1.129) | (1.079) |
| **Gender** | | | | |
| Female | 1.090 | 0.150 | 1.114 | 0.109 |
| | (2.199) | (2.388) | (2.029) | (2.205) |
| Male | -0.667 | -1.086 | -0.667 | -1.086 |
| | (0.778) | (0.817) | (0.778) | (0.817) |
| **Race** | | | | |
| White | 0.612 | 0.335 | 0.616 | 0.341 |
| | (0.941) | (0.865) | (0.942) | (0.865) |
| Black | 2.180 | -0.326 | 0.175 | -1.527 |
| | (7.239) | (6.966) | (3.837) | (3.598) |
| **Age** | | | | |
| 10-34 | -0.469 | -0.561 | -0.774 | -0.893 |
| | (1.559) | (1.558) | (1.480) | (1.490) |
| Observations | 1,363 | 1,363 | 1,363 | 1,363 |
| State FE | Yes | Yes | Yes | Yes |
| Month Year FE | Yes | Yes | Yes | Yes |
| Controls | No | Yes | No | Yes |

*Notes: This table presents Poisson Pseudo-Maximum Likelihood estimates of various heterogeneous effects on suicides when the values 0 and 10 are imputed for missing suicides. The coefficients for Poisson pseudo-maximum likelihood are transformed the following way:* $100 \times [e^{\beta} - 1]$*. Columns with "Yes" under Controls include additional covariates, SAMHSA funding, and the unemployment rate. The coefficients displayed are for the "Legislation × Post" term which represents the treatment effect of the legislation. Standard errors are reported in parentheses, and significance levels are denoted by *, **, and *** for* $p < 0.1$, $p < 0.05$, *and* $p < 0.01$, *respectively. The model is weighted by state population and standard errors are clustered by state.*