# The Political Economy of Death: Do Coroners perform as well as Medical Examiners in determining suicide?*

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December 16, 2018

**Abstract**

The determination of death in the United States can have strong financial implications. For example, a declaration of suicide can nullify life insurance benefits. However, the intent of death may be made by an elected official who is not required to have any medical training. Medical examiners and coroners determine cause of death when the death is sudden, violent, or untimely. Consequently, these officials can affect counts of sudden infant death syndrome, homicide, and suicide in a state. This paper uses a difference-in-differences model to estimate the effect of elected coroners versus appointed medical examiners on a state's suicide rate. Elected coroners need not receive training in 13 states, must receive initial and continuous training in 16 states, and are required to be physicians in 4 states. We exploit state policy changes to the minimum required training elected coroners must complete. Data on the underlying intent of death is collected from the CDC Wonder mortality files from 1968 - 2016.

**Keywords**: suicide, medical examiners, coroners, elections, training

**JEL Classification Codes**: H75, I18, K16

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# 1 Introduction

Death investigation in the United States is conducted by a network of medical examiners and coroners. Medical examiners are physicians, often board certified forensic pathologist, who are appointed. Coroners are primarily elected officials who do not require any formal education or training in medicine or forensic pathology.[1] A common minimum requirement is that the coroner be a legal resident of the state and at least 21 years of age. There are only four states (Kansas, Louisiana, Minnesota, and Ohio) that require elected coroners to be physicians.[2] Further, of the 28 states who elected their coroners only 17 states require additional training in death investigation.[3] This paper explores if the lack of training produces heterogeneity in death determination between medical examiners and coroners. Can electoral competition produce candidates of sufficient quality to close this discrepancy in minimum qualification requirements between medical examiners and coroners?

We are concerned with the reporting accuracy of deaths. The consequences of misclassificaiton can have economic ramifications. For example, higher rates of suicide may affect life insurance premiums or nullify specific claims. The number of SIDS cases appear to be over counted by coroners relative to medical examiners (Walsh et al. 2010). Delays in death determination are associated with a decrease in cadaveric organ donations (Shafer et al. 1994, 2004). Timmermans (2005) reports that medical examiners under count the number of suicides relative to epidemiological studies because they do not use previous history of the person (i.e. previous attempts of suicide) when making a death determination. Therefore, some deaths may be mis-classified as accidents or undetermined.

Ruhm (2018) finds evidence of similar classification error with respect to opioid-related deaths. Death certificates often failed to disclose the actual drug leading to death. Ruhm (2018) applies a correction procedure and finds opioid related drug deaths are undercounted in most years by 20 - 35 percent. Previous research has hypothesized that classification differences are due to varied definitions of death in state statues (Hanzlick and Parrish 1996; Hanzlick 2006; Ruiz et al. 2018) and the lack of trained forensic pathologist or coroners (Hanzlick 1996).

[1] Roughly 83 percent of coroners are elected and 17 percent are elected (Council et al. 2009)

[2] In Nebraska, the office of coroner is jointly held with the county attorney. Therefore, all coroners are lawyers.

[3] Most training programs require a 40 hour training session for new coroners during their first year followed by 8 hour training sessions in subsequent years. This training requirement can be waived for individuals with medical experience. The CDC reports which states requiring training. The state of New York recently passed a law (Aug. 2017) requiring coroners to receive training. Link: CDC Coroner Training Requirements.

The work most similar to our own is by Klugman et al. (2013). The authors study the effect of elected coroners versus medical examiners and appointed coroners on geographic variation in suicide rates. Using county level data from 1999-2002, elected coroners are found to have slightly lower reported suicide rates relative to medical examiners. However, the model does not control for county specific fixed effects or coroner training requirements.[4] The article is unable to conclude a causal relationship between elected coroners and suicide rates without observing within county variation in the policy variables.

We improve on the previous research by collecting state level variables from 1968 - 2016, which increases the sample time period window. The additional years of observation not only allows us to observe changes in type of death investigator within a state, but also changes in training requirements for elected coroners. We exploit the panel nature of our data by including both state and year fixed effects to estimate the treatment effect using a difference in differences specification. We find little evidence that required coroner training programs significantly effects the counts of accidents or suicides in a state. However, we find states with a centralized medical examiner system, and to a lesser extend coroner states with a state medical examiner, report a significantly higher suicide death rate and a lower accidental death rate relative to states with county coroners and no state medical examiner. These results hold both by gender and race of the deceased. A similar substitution effect between accidents and suicides appears for both firearm and non-firearm deaths. The proportion of deaths classified as homicide are not found to be statistically different by death investigator type.

## 1.1 History of Coroners and Medical Examiners in the US

Coroners have existed since the 11th century (Gross 1892). Often coroners would hold joint appointments as the justice of the peace, sheriff, or county attorney. The introduction of medical examiner systems did not begin in the United States until 1868 in Maryland (Jentzen 2010). Coroners and medical examiners are called upon to determine death when the death occurred by violent or external means. These deaths constitute about 20 percent of total deaths each year and include homicides, suicides, accidental deaths (drug overdose, car accidents, etc), and deaths due to legal intervention or military service (Hanzlick 2003). Coroners' offices account for 80 percent of all

[4]According to Hanzlick (2007) only five counties changed status between 1999-2002: Weld, CO (2000); Cass, MO (2001); Spokane, WA(1999); Fond du Lac, WI (1999); Dodge, WI (2000);

death investigation facilities (Hickman et al. 2007). Therefore, measurement error in determining death between medical examiners and coroners could have widespread consequences.

There are four types of death investigation systems: centralized system of medical examiners, a decentralized system of county medical examiners, a mixture of county coroners and medical examiners, and only county coroners. A centralized system of medical examiners is found in 16 states and includes only appointed medical examiners covering various regions of the state with a statewide chief medical examiner. A decentralized system of county medical examiners exist in 6 states. In these states, medical examiners are found in each county, but there is no centralized state authority. The remaining states have the majority of death investigation done by coroners, but some counties, particularly large population counties, have moved to county level medical examiners. Of the 28 states with coroners, 25 states have an appointed state medical examiner at their disposal to perform autopsies and provide an opinion, but the coroner still determines death.

Hanzlick (2007) finds two significant transition periods. Twelve states adopted either a centralized medical examiner system or a state medical examiner from 1960 to 1979. Less than four states transition in the 20 years before and after this period. Between 1960 to 2006, 960 counties transition from county coroners to county medical examiners. The transition rate had a peak during the 1980s and has been in steady decline since. We calculate that of the 28 states with elected coroners, none required training in 1968, but by 2017 seventeen states required training. A long panel dataset is needed to capture these periods of transition. We list the transition years for each state in tables 1 and 2.

## 2 Data

This study uses US state level mortality data from the Compressed Mortality File 1968-2016.[5] For the years 1979-2016, we use the CDC classification of injury intent, which includes accidents, suicide, homicide, undetermined, and legal intervention. The classification for injury intent is not available for the years 1968-1978. Instead we aggregate the following ICD-8 codes for each category: accidental (E800-E949), suicide (E950-E959), homicide (E960-E969), Legal intervention/operation of

[5]Centers for Disease Control and Prevention, National Center for Health Statistics. Compressed Mortality File 1999-2016, 1979-1998, and 1968-1978 on CDC WONDER Online Database, released June 2017. Data are from the Compressed Mortality File 1999-2016 Series 20 No. 2U, 2016, as compiled from data provided by the 57 vital statistics jurisdictions through the Vital Statistics Cooperative Program. Accessed at CDC Wonder

war (E970-E978 and E990-E999), and undetermined (E980-E989). State level values are used instead of county level values because the CDC censors counts less than nine. The analysis is limited to accidents, suicides, and homicides as these categories are rarely censored at the state level. The data are disaggregated by gender, race, and the involvement of a firearm. Descriptive statistics are reported in Table 3. Accidental deaths account for nearly 70 percent of all violent deaths followed by suicide at 30 percent and homicide at 10 percent. Only 13 percent of deaths in our sample had an autopsy performed.

We construct a set of death investigation system dummy variables as our treatment variables. The state specific dates of transition are identified based on the work by Hanzlick and Combs (1998) and Hanzlick (2007). These results are supplemented by the Center Center for Disease Control and Prevention (2018) Public Health Law Program: Coroner/Medical Examiner Laws, by State database. This database provides the corresponding state statues associated with qualifications for the office, required training, and type of death investigation system. We verify the dates from these sources by consulting the state statues directly, local newspaper articles, and phone inquiries when necessary. In Figure 1, we illustrate the change in death investigation type from the beginning to end our sample period. States with either a centralized medical examiner system or only county medical examiners are indicated in red. Medical examiner states increased by 7 and states with a mix of county level coroners & medical examiners increased by 6 over this time period. In Figure 2, we display the transition of coroner states that require training or a medical degree. Only Minnesota required training of their elected coroners in 1968. By 2016, 16 states required a minimum of 20 hours training. Additionally, Ohio and Minnesota mandated that coroners must be physicians. Lastly, we construct a continuous variable indicating the percentage of the state population covered by a county medical examiner. This variable holds the value of one in states with a decentralized medical examiner system and zero in states with no medical examiners. We exclude centralized medical examiner systems from this measure (i.e. the variable is set to zero in this case).

State level demographic variables are collected from various sources. State population and income per capita are obtained from the US Bureau of Economic Analysis Regional Economic Accounts data. State unemployment rates are collected from FRED Economic data of the Federal Reserve Bank of St. Louis.[6] Household characteristics are estimated using the Integrated Public Use Microdata

[6]U.S. Bureau of Labor Statistics, Unemployment Rate by state between 1976-2016, retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/, November 1, 2018.

Series (IPUMS), created by the Minnesota Population Center at the University of Minnesota and the American Community Survey. Previous research has identified the following variables as having a significant effect on suicide counts: marital status, state income per capita, gender, race, education, and poverty rate (Hamermesh and Soss 1974, Yang and Lester (1995), Chuanc and Huang (1997), Denney et al. (2009)).

Descriptive statistics for our treatment and control variables are report in Table 4. Centralized state medical examiners account for 29 percent of our sample. Almost 25 percent of the population is covered by county medical examiners. States with county coroners and state medical examiners account for 14 percent of the observations. Coroner training is require in 14 percent of the observations. States with centralized medical examiner systems are more educated, have higher populations, and have higher state income per capita level relative to states with county coroners.

# 3 Model

Death data are count in nature. We use a Poisson fixed effects model to capture the relationship between state death investigation systems and different types of violent death. The conditional mean of the death rate is modeled as

$$ln(E[d/p]) = \beta_1 PctME + \beta_1 CoronerTrained + \beta_2 CentralizedME + \beta_3 StateME + \Gamma X + u_i + \omega_t \quad (1)$$

where d is the count of deaths by type (suicide, accidental, or homicide) and p is the population of interest, Γ is a vector of parameters to be estimated, and X is a matrix of state demographic variables. The population of interest in most of our specifications is the total number of violent deaths. Total deaths are selected over the state population as only violent deaths are evaluated by coroners and medical examiners.[7] The endogenous classification of death made by coroners/medical examiners only occurs with violent deaths, not deaths in general.

The treatment variables are the following: PctME is the percentage of the population covered by county medical examiners, CoronerTrained is a dummy variable equal to unity if the state requires coroners to complete yearly training, CentralizedME is a dummy variable equal to unity if the

[7] We supply results using state population for comparison in Table 6.

state has a centralized medical examiner system, and StateME is a dummy variable equal to unity if the state has a state medical examiner, but coroners serve at the county level. The state demographic variables used as controls are percentage of Caucasians, percentage of African Americans/Blacks, percentage of females, percentage with a College degree, percentage with a High School diploma, percentage under 5 years old, percentage between 5-17 years old, percentage greater than 64 years old, natural logarithm of the state population, natural logarithm of the state income per capita, percentage married, percentage separated, percentage widowed, and percentage divorced.

The error structure includes a state fixed effect $u_i$ and a year fixed effect $\omega_t$. The state fixed effect accounts for unobserved time-invariant difference between states. The year fixed effects captures changes over time that affect each state equally (i.e. changes in federal laws or inflation). The parameters of interests $\beta$ are identified by within state variation in the treatment variables.

The fixed effect Poisson model has the advantage of not suffering from the incidental parameter problem found in most non-linear models (Hausman et al. 1984). The disadvantage of the Poisson model is the assumption of equal conditional mean and variance. This assumption is often violated leading to over-dispersion and biased estimates of the standard errors. We adopt two approaches to correct the standard errors for over dispersion. First, we estimated the model using quasi-maximum likelihood and cluster the standard errors by state as suggested by Wooldridge (1999). Wooldridge (1999) demonstrates the quasi-maximum likelihood model is robust to over-dispersion and consistent even when the underlying count error is not distributed Poisson. Second, we report bootstrapped standard errors clustered by state as suggested by Cameron and Trivedi (2005). These standard errors also correct for over-dispersion, but are less efficient than those found using quasi-maximum likelihood. Both standard errors are reported in our results.

# 4 Results

## 4.1 Main Results

We report the estimated coefficients of our treatment variables in Tables 5 - 7. All regression equations include a full set of demographic control variables, year dummy variables, and state fixed effects. Robust-clustered standard errors are reported in parenthesis. Bootstrapped clustered standard errors are reported in brackets. The reference group for all our treatment coefficients are states with only county coroners who do not require training and have no state medical examiner. In the text, we report statistically significant finding using the robust-clustered standard errors.

Similar to the model estimated in Klugman et al. (2013), we estimate a simple Poisson regression in model 1, then gradually add additional controls and fixed effects. We report these coefficients in Table 5. We initially find that states who mandate coroner training report 6.7 percent more suicides than those without. However, this estimate becomes statistically insignificant once we control for observable state characteristics, year fixed effects, and state fixed effects. We find strong evidence that states with a centralized medical examiner reports between 11 - 16 percent higher rate of suicides than coroner controlled states. Likewise, coroner states with a state medical examiner report a similar increase in suicide rates of 11 percent. These results highlight the importance of including state fixed effects in the analysis.

We extend Klugman et al. (2013) to include other forms of violent death. Table 6 reports the estimated effect of death investigation type on the ratio of accidents, suicides, homicides, and autopsies per capita. Accidents and suicides per capita are higher in states with more county medical examiners. A 10 percent increase in the population covered by medical examiners increases the count of accidents by 1 percent and suicides by 1.6 percent relative to states with only county coroners. Both estimates are significant at the 1 percent level. Similarly, states with a centralized state medical examiner system observe 14 percent more suicides, but 5 percent fewer accidents. We find no statistically significant effect of coroner training on suicides or accidents per capita. We find no discernible difference in autopsy rates per capita between systems.

Next, we consider the same model, but change the relative base from state population to total violent deaths. Coroners/medical examiners only make death determinations when there is a violent death. The ratio of suicide to total deaths should be more sensitive to type of death investigation than the ratio of suicide to the population. Our identifying assumption is that the “true” proportions of suicide relative to all violent deaths should be determined by state demographic characteristics and not the decisions of coroners/medical examiners. Any observed deviation between coroner and medical examiner states must be due to difference in interpretation of death and not some other underlying pattern. Further, the treatment effects captures within state changes in these death types to mitigate the effect of unobserved time invariant factors. That is, the estimated treatment effects are not reliant on difference across states, only differences within a state.

Table 7 reports the results of the count model relative to total violent deaths. Coroner Training again is not found to significantly affect accidents, suicide, or homicide. However, a substitution pattern between accidents and suicides appears in states with a chief medical examiner. Centralized state medical examiners systems report 16 percent more suicides and 4 percent fewer accidents without a significant change in homicides. Likewise, states with county coroners and a state medical examiner experience 8 percent more suicides and 2.8 percent fewer accidents without a significant change in homicides. These states also perform 13 percent more autopsies relative to states without a state medical examiner. We no longer find a significant relationship between the percentage of the population covered by county medical examiners and the counts of accidents, suicides, or homicides, but the point estimates suggest the same substitution pattern as those found with states with a chief medical examiner.

In Tables 8 - 11, we disaggregate our data to compare gender and race differences in death determination. Both Coroner training and county medical examiners do not affect female accident, suicide, or homicide counts. Centralized state medical examiners report 5 percent fewer female accident deaths and 23 percent more suicide deaths. Both estimates are significant at the 1 percent level. Similarly, states with a chief medical examiner report 8 percent more female suicide deaths and 1.5 percent fewer accidents, but these coefficients are estimated with less precision.

Coroner Training is found to decrease the number of male suicides reported by 3 percent and increase the number of homicides reported by 7.8 percent. Both estimates are significant at the 10 percent level. Centralized state medical examiners report 13 percent more male suicides, significant at the 5 percent level, and 3.3 fewer accidents, not significant. Coroner states with chief medical examiners also report 8.5 percent more male suicides and 3.3 percent fewer male accidents. Both estimates are significant at the 5 percent level.

When comparing death determination by race, we find coroner training leads to an 11 percent reduction in the number of black suicides and a 6 percent increase in the number of black homicides without any discernible change for white deaths. Further, centralized state medical examiners report 17 percent fewer black accidental deaths relative to 3.9 percent fewer white accidental deaths and 26 percent more black suicides relative to 14 percent more white suicide deaths. The difference in magnitude from these estimates could potentially be explained by CDC censoring of deaths less than 9. The sample size for black violent deaths by state-year is 1,749 observations, but white violent deaths have 2,387 observations.

## 4.2 Robustness Checks

As a robustness test, we disaggregate violent deaths into firearm and non-firearm deaths. We should expected there to be less variation in suicide determination between coroners and medical examiners when a firearm is used. In Table 12, we find that most of the increase in suicide deaths are found in states with medical examiners. Both centralized and de-centralized systems of medical examiners report 9 percent more suicide deaths by firearm than county coroners. However, non-firearm deaths resulting in suicide are 24 percent higher in states with a centralized medical examiner and 18 percent higher in states with county coroners and a state medical examiner. Therefore, the larger observed suicide rate in states with state medical examiners (both centralized and non-centralized) are due to more non-firearm deaths being declared suicides relative to states with county coroners. Non-firearm deaths are potentially more difficult to ascertain the actual cause/intent of death. For example, drug overdoses could be accidental or intentional. These deaths would often require an autopsy, which is easier to obtain if there is a state medical examiner.

A second robustness test is to include the state unemployment rate. Yang and Lester (1995) finds state unemployment rates to positive correlated with suicide rates. Case and Deaton (2017) argue increases in middle age suicide and drug use is due to prolong economic downturns. Harper et al. (2015) find the *Great Recession* of 2008 increased suicide mortality by 0.14 deaths per 100,000 population. As reported in Table 13, the pattern of over reporting accidents and under reporting suicides continues for state with county coroners. Consistent with previous research, we find an increase in unemployment of 1 percent decreases accidents by 0.4 percent and increases suicide by 1.7 percent. After including the state unemployment rate, coroner training is found to reduce the number of deaths by accidents, but the magnitude is still less than alternative systems that have medical examiners. We lose some precision of our estimates for the effect of centralized state medical examiners, but maintain the same pattern found in the previous results. Recall, most transition of states becoming centralized medical examiners systems occurred from 1960 to 1979, but our state unemployment data does not begin until 1976. We lose several transition periods due to data limitations.

### 4.3 Caveats

The CDC censoring rule may adversely affects our regressions results. The number of homicide observations is reduced by 216 due to censoring. These censored values primarily cause small population states to be under sample. Similarly, the censoring rule reduces the sample by 701 observations when we investigate African Americans deaths. This reduction occurs in states where African American comprise a small proportion of the population. This paper currently utilized the publicly available CDC Compressed Mortality files. We are petitioning the CDC to obtain non-censored de-identified values for all states and years.

As a robustness check, we replace the CDC values for homicide with murder counts from the Uniform Crime Reports (UCR) of FBI. A simple regression of the CDC homicide counts on the UCR FBI counts yields an $R^2$=0.9918. We estimate our primary model using murder counts from the UCR to regain our censored count values and report our results in Table 14. The estimated coefficients are very similar both in magnitude and significance to those found using only the CDC data in Table 7.

## 5 Conclusion

In this article, we estimate the effect of death investigation systems on the rates of suicide, homicide, and accidental deaths by state. We improve on previous research by adopting a longer panel dataset from 1968-2016. The longer panel allows us to observe within state transitions from coroner to medical examiner systems. Using a standard difference in differences approach, we estimate that states with county coroners under-report the number of suicide deaths by 8.6 to 16 percent relative to states with a state medical examiner. These results are consistent with the findings of Klugman et al. (2013) repeated cross-sectional study. These results do not support the conclusions of Timmermans (2005) that suggest medical examiners under-report suicides due to stringent definitions.

We believe this mis-classifications of suicides is driven by declaring potential suicides as accidents. Accidental deaths are 2 to 4 percent higher in states with county coroners. We find the largest difference in suicide counts are associated with non-firearm deaths. The rate of suicides relative to non-firearm deaths increases by 24 percent when transition from a county coroner system into a centralized medical examiners systems and by 18 percent in states that adopt a state medical examiner.

Second, we test if supplying coroners with training diminishes the differences in suicide rates between coroners and medical examiners. We observe 16 states adopt laws requiring coroners to annual training. However, we find no discernible effect of training on accident and suicide death determination.

Calls for additional coroner training as suggested by Hanzlick (1996) may not actually diminish the discrepancies between coroners and medical examiners. The strongest changes occur when a state adopts a centralized medical examiner system. However, such a transition can be very costly to states and the number of active forensic pathologist is limited (Elinson 2015). According to Hickman et al. (2007), the mean operating budget for a county coroners office is $225,000 and a county medical examiners office is $715,000. Instead, states can appoint a state level medical examiner to serve county coroners at a lower cost. Our results suggest these state medical examiners significantly reduce the mis-classifications rate even in states with only county coroners.

# 6 Tables

Table 1: Year of Death Investigation Law Change

| State | Centralized ME | De-Centralized ME | State ME | Coroner Training |
|---|---|---|---|---|
| Alabama | | | 1977 | 2007 |
| Alaska | 1996 | | | |
| Arizona | | 1976 | | |
| Arkansas | | | 1979 | |
| Colorado | | | | 2014 |
| Connecticut | 1969 | | | |
| Delaware | 1970 | | | |
| Florida | | 1970 | | |
| Georgia | | | 1990 | 1987 |
| Idaho | | | | 2010 |
| Illinois | | | | 1990 |
| Indiana | | | | 1998 |
| Iowa[a] | 1961 | | | |
| Kentucky | | | 1977 | 1982 |
| Maine | 1968 | | | |
| Maryland | 1939 | | | |
| Massachusetts | 1983 | | | |
| Michigan | | 1969 | | |
| Minnesota[b] | | | | 1965 |

ME = Medical Examiner. *a* Iowa state medical examiner remained vacant until 1983. North Dakota requires that coroners have some medical training (i.e. physician, physician assistant, registered nurse, nurse practitioner) or be approved by the state medical examiner. *b* Minnesota the coroner must be physician from 2005 onward. *c* In Nebraska, the county attorney is also the coroner.

Table 2: Year of Death Investigation Law Change

| State | Centralized ME | De-Centralized ME | State ME | Coroner Training |
|---|---|---|---|---|
| Mississippi | | | 1986 | 1987 |
| Montana | | | 1980 | 1987 |
| Nebraska[c] | | | | 2009 |
| New Hampshire | 1986 | | | |
| New Jersey | 1978 | | | |
| New Mexico | 1976 | | | |
| North Carolina | 1967 | | | |
| Ohio | | | | 2001 |
| Oklahoma | 1963 | | | |
| Oregon | 1964 | | | |
| Pennsylvania | | | | 1988 |
| Rhode Island | 1949 | | | |
| South Carolina | | | | 1994 |
| South Dakota | | | | 2010 |
| Tennessee | 1961 | | | |
| Utah | 1967 | | | |
| Vermont | 1948 | | | |
| Virginia | 1947 | | | |
| West Virginia | 1976 | | | |
| Wyoming | | | | 1987 |

ME = Medical Examiner. *a* Iowa state medical examiner remained vacant until 1983. North Dakota requires that coroners have some medical training (i.e. physician, physician assistant, registered nurse, nurse practitioner) or be approved by the state medical examiner. *b* Minnesota the coroner must be physician from 2005 onward. *c* In Nebraska, the county attorney is also the coroner.

Table 3: Violent Deaths in the US: 1968-2016

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| VARIABLES | N | mean | sd | min | max |
| Share of Accidental Deaths | 2,433 | 0.695 | 0.058 | 0.458 | 0.887 |
| Share of Suicide Deaths | 2,433 | 0.205 | 0.046 | 0.067 | 0.372 |
| Share of Homicide Deaths | 2,433 | 0.100 | 0.051 | 0.004 | 0.311 |
| Share of Deaths with Autopsy | 1,800 | 0.129 | 0.069 | 0.028 | 0.567 |
| Accidental Deaths per 1 million people | 2,450 | 455 | 135 | 191 | 1,208 |
| Suicide Deaths per 1 million people | 2,450 | 130 | 34.7 | 59.6 | 296 |
| Homicide Deaths per 1 million people | 2,433 | 65.0 | 36.7 | 3.22 | 209 |
| Autopsy per 1 million people | 1,800 | 893 | 378 | 27.3 | 2,740 |

Total deaths are calculated using only the counts of accidental, suicide, and homicide deaths.

Table 4: Demographic Variables

| VARIABLES | (1)<br>N | (2)<br>mean | (3)<br>sd | (4)<br>min | (5)<br>max |
|---|---|---|---|---|---|
| Pct State Level ME - Centralized | 2,450 | 0.287 | 0.453 | 0 | 1 |
| Pct Coroner Required Training | 2,450 | 0.143 | 0.350 | 0 | 1 |
| Pct Coroner Physician | 2,450 | 0.071 | 0.257 | 0 | 1 |
| Pct State Level ME - Coroner Local | 2,450 | 0.138 | 0.345 | 0 | 1 |
| Pct Poverty | 2,450 | 0.132 | 0.041 | 0.035 | 0.359 |
| Pct High School | 2,450 | 0.430 | 0.067 | 0.208 | 0.557 |
| Pct College | 2,450 | 0.137 | 0.053 | 0.004 | 0.315 |
| Pct Married - Spouse Present | 2,450 | 0.423 | 0.031 | 0.323 | 0.529 |
| Pct Married - Spouse Absent | 2,450 | 0.013 | 0.005 | 0.001 | 0.041 |
| Pct Separated | 2,450 | 0.014 | 0.006 | 0 | 0.031 |
| Pct Divorced | 2,450 | 0.064 | 0.025 | 0 | 0.126 |
| Pct Widowed | 2,450 | 0.053 | 0.010 | 0.016 | 0.076 |
| Pct Female | 2,450 | 0.509 | 0.009 | 0.447 | 0.525 |
| Pct Black | 2,450 | 0.100 | 0.094 | 0.001 | 0.382 |
| Pct White | 2,450 | 0.852 | 0.119 | 0.297 | 0.997 |
| Pct under 5 years old | 2,450 | 0.073 | 0.011 | 0.048 | 0.132 |
| Pct between 5-17 years old | 2,450 | 0.233 | 0.036 | 0.167 | 0.355 |
| Pct over 64 years old | 2,450 | 0.121 | 0.024 | 0.021 | 0.199 |
| Pct of Pop. Covered by ME | 2,450 | 0.249 | 0.375 | 0 | 1 |
| State Population (millions) | 2,450 | 5.21 | 5.76 | 0.29 | 39.51 |
| State Income per Capita | 2,450 | $22,563 | $14,425 | $2,494 | $70,293 |

ME = Medical Examiner. Nebraska coroners are required to be lawyers.

Table 5: Rate of Suicide by Violent Death

| VARIABLES | (1)<br>Model 1 | (2)<br>Model 2 | (3)<br>Model 3 |
|---|---|---|---|
| Pct of Pop. Covered by ME | 0.1161* | 0.1180* | 0.0368 |
| | (0.0592) | (0.0709) | (0.0479) |
| Coroner Required Training | 0.0673** | -0.0076 | -0.0298 |
| | (0.0342) | (0.0306) | (0.0184) |
| State Level ME - Centralized | 0.1125* | 0.1835** | 0.1602** |
| | (0.0613) | (0.0923) | (0.0653) |
| State Level ME - Coroner State | -0.1112** | 0.1562*** | 0.1081*** |
| | (0.0447) | (0.0431) | (0.0376) |
| Observations | 2,433 | 2,433 | 2,433 |
| Control Variables | No | No | Yes |
| State FE | No | Yes | Yes |
| Year FE | No | Yes | Yes |
| Number of fips | | 50 | 50 |

*** p<0.01, ** p<0.05, * p<0.1 Robust standard errors clustered by state are in parentheses. Bootstrapped standard errors cluster by state are in brackets. Control variables include percent White, percent Black, percent Female, percent with College Education, percent with High School Education, percent under 5 years old, percent between 5-17 years old, percent greater than 64 years old, log state population, log state income per capita, percent married, percent separated, percent widowed, and percent divorced. The exposure variable is state population.

Table 6: Poisson Regression: Rate of Death Type by Population

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| VARIABLES | Accidents | Suicide | Homicide | Autopsy |
| Pct of Pop. Covered by ME | 0.1060 | 0.1667 | 0.1341 | 0.0356 |
| | (0.0392)*** | (0.0480)*** | (0.0972) | (0.0970) |
| | [0.0553]* | [0.0632]*** | [0.1323] | [0.1675] |
| Coroner Required Training | 0.0117 | -0.0024 | 0.0938 | 0.0021 |
| | (0.0206) | (0.0159) | (0.0485)* | (0.0552) |
| | [0.0324] | [0.0200] | [0.0659] | [0.0769] |
| State Level ME - Centralized | -0.0573 | 0.1421 | 0.0945 | 0.0744 |
| | (0.0330)* | (0.0674)** | (0.0879) | (0.1031) |
| | [0.0499] | [0.0758]* | [0.1178] | [0.1479] |
| State Level ME - Coroner State | -0.0801 | 0.0246 | 0.0266 | 0.0852 |
| | (0.0346)** | (0.0337) | (0.1008) | (0.0540) |
| | [0.0507] | [0.0529] | [0.1711] | [0.0917] |
| Observations | 2,450 | 2,450 | 2,433 | 1,800 |
| Number of fips | 50 | 50 | 50 | 50 |
| Control Variables | Yes | Yes | Yes | Yes |
| State FE | Yes | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes |

*** $p<0.01$, ** $p<0.05$, * $p<0.1$ Robust standard errors clustered by state are in parentheses. Bootstrapped standard errors cluster by state are in brackets. Control variables include percent White, percent Black, percent Female, percent with College Education, percent with High School Education, percent under 5 years old, percent between 5-17 years old, percent greater than 64 years old, log state population, log state income per capita, percent married, percent separated, percent widowed, and percent divorced. The exposure variable is state population.

Table 7: Poisson Regression: Rate of Death Type by Total Violent Deaths

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| VARIABLES | Accidents | Suicide | Homicide | Autopsy |
| Pct of Pop. Covered by ME | -0.0213 | 0.0345 | 0.0197 | -0.1288 |
| | (0.0160) | (0.0474) | (0.0715) | (0.0997) |
| | [0.0208] | [0.0675] | [0.0990] | [0.1860] |
| Coroner Required Training | -0.0047 | -0.0230 | 0.0687 | -0.0240 |
| | (0.0084) | (0.0188) | (0.0387)* | (0.0635) |
| | [0.0103] | [0.0272] | [0.0510] | [0.0893] |
| State Level ME - Centralized | -0.0429 | 0.1609 | 0.1185 | 0.0538 |
| | (0.0223)* | (0.0660)** | (0.0757) | (0.1022) |
| | [0.0267] | [0.0790]** | [0.0974] | [0.1542] |
| State Level ME - Coroner State | -0.0283 | 0.0861 | 0.0663 | 0.1349 |
| | (0.0145)* | (0.0329)*** | (0.0771) | (0.0608)** |
| | [0.0222] | [0.0450]* | [0.1226] | [0.1068] |
| Observations | 2,433 | 2,433 | 2,433 | 1,789 |
| Number of fips | 50 | 50 | 50 | 50 |
| Control Variables | Yes | Yes | Yes | Yes |
| State FE | Yes | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes |

*** p<0.01, ** p<0.05, * p<0.1 Robust standard errors clustered by state are in parentheses. Bootstrapped standard errors cluster by state are in brackets. Control variables include percent White, percent Black, percent Female, percent with College Education, percent with High School Education, percent under 5 years old, percent between 5-17 years old, percent greater than 64 years old, log state population, log state income per capita, percent married, percent separated, percent widowed, and percent divorced. The exposure variable is total violent deaths.

Table 8: Poisson Regression: Rate of Death Type by Total Violent Deaths - Female

| | (1) | (2) | (3) |
|---|---|---|---|
| VARIABLES | Accidents | Suicide | Homicide |
| Pct of Pop. Covered by ME | -0.0192 | 0.0035 | -0.0093 |
| | (0.0131) | (0.0512) | (0.0528) |
| | [0.0199] | [0.0789] | [0.0843] |
| Coroner Required Training | 0.0019 | -0.0259 | 0.0294 |
| | (0.0062) | (0.0276) | (0.0267) |
| | [0.0079] | [0.0379] | [0.0344] |
| State Level ME - Centralized | -0.0543 | 0.2283 | 0.1667 |
| | (0.0172)*** | (0.0725)*** | (0.0798)** |
| | [0.0229]** | [0.1002]** | [0.1035] |
| State Level ME - Coroner State | -0.0149 | 0.0800 | 0.0409 |
| | (0.0097) | (0.0402)** | (0.0505) |
| | [0.0146] | [0.0604] | [0.0801] |
| Observations | 2,234 | 2,234 | 2,234 |
| Number of fips | 50 | 50 | 50 |
| Control Variables | Yes | Yes | Yes |
| State FE | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes |

*** $p<0.01$, ** $p<0.05$, * $p<0.1$ Robust standard errors clustered by state are in parentheses. Bootstrapped standard errors cluster by state are in brackets. Control variables include percent White, percent Black, percent Female, percent with College Education, percent with High School Education, percent under 5 years old, percent between 5-17 years old, percent greater than 64 years old, log state population, log state income per capita, percent married, percent separated, percent widowed, and percent divorced. The exposure variable is total violent deaths among females.

Table 9: Poisson Regression: Rate of Death Type by Total Violent Deaths - Male

| VARIABLES | (1) Accidents | (2) Suicide | (3) Homicide |
|---|---|---|---|
| Pct of Pop. Covered by ME | -0.0225 | 0.0510 | 0.0355 |
| | (0.0177) | (0.0469) | (0.0794) |
| | [0.0224] | [0.0644] | [0.1077] |
| Coroner Required Training | -0.0051 | -0.0296 | 0.0782 |
| | (0.0099) | (0.0177)* | (0.0434)* |
| | [0.0124] | [0.0261] | [0.0577] |
| State Level ME - Centralized | -0.0334 | 0.1351 | 0.1044 |
| | (0.0247) | (0.0658)** | (0.0829) |
| | [0.0293] | [0.0774]* | [0.1075] |
| State Level ME - Coroner State | -0.0333 | 0.0851 | 0.0795 |
| | (0.0169)** | (0.0323)*** | (0.0851) |
| | [0.0272] | [0.0470]* | [0.1413] |
| Observations | 2,387 | 2,387 | 2,387 |
| Number of fips | 50 | 50 | 50 |
| Control Variables | Yes | Yes | Yes |
| State FE | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes |

*** $p<0.01$, ** $p<0.05$, * $p<0.1$ Robust standard errors clustered by state are in parentheses. Bootstrapped standard errors cluster by state are in brackets. Control variables include percent White, percent Black, percent Female, percent with College Education, percent with High School Education, percent under 5 years old, percent between 5-17 years old, percent greater than 64 years old, log state population, log state income per capita, percent married, percent separated, percent widowed, and percent divorced. The exposure variable is total violent deaths among males.

Table 10: Poisson Regression: Rate of Death Type by Total Violent Deaths - White

| | (1) | (2) | (3) |
|---|---|---|---|
| VARIABLES | Accidents | Suicide | Homicide |
| Pct of Pop. Covered by ME | -0.0239 | 0.0240 | 0.1018 |
| | (0.0129)* | (0.0459) | (0.0620) |
| | [0.0176] | [0.0639] | [0.0985] |
| Coroner Required Training | -0.0012 | -0.0125 | 0.0349 |
| | (0.0067) | (0.0179) | (0.0345) |
| | [0.0085] | [0.0243] | [0.0453] |
| State Level ME - Centralized | -0.0392 | 0.1414 | 0.1376 |
| | (0.0178)** | (0.0555)** | (0.0741)* |
| | [0.0225]* | [0.0695]** | [0.0941] |
| State Level ME - Coroner State | -0.0300 | 0.0769 | 0.1424 |
| | (0.0134)** | (0.0336)** | (0.0761)* |
| | [0.0214] | [0.0498] | [0.1390] |
| Observations | 2,389 | 2,389 | 2,389 |
| Number of fips | 50 | 50 | 50 |
| Control Variables | Yes | Yes | Yes |
| State FE | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes |

*** p<0.01, ** p<0.05, * p<0.1 Robust standard errors clustered by state are in parentheses. Bootstrapped standard errors cluster by state are in brackets. Control variables include percent White, percent Black, percent Female, percent with College Education, percent with High School Education, percent under 5 years old, percent between 5-17 years old, percent greater than 64 years old, log state population, log state income per capita, percent married, percent separated, percent widowed, and percent divorced. The exposure variable is total violent deaths among the white population.

Table 11: Poisson Regression: Rate of Death Type by Total Violent Deaths - Black

| VARIABLES | (1) Accidents | (2) Suicide | (3) Homicide |
|---|---|---|---|
| Pct of Pop. Covered by ME | 0.0239 | 0.1100 | -0.0359 |
| | (0.0297) | (0.0800) | (0.0456) |
| | [0.0740] | [0.1605] | [0.1150] |
| Coroner Required Training | -0.0358 | -0.1131 | 0.0613 |
| | (0.0237) | (0.0446)** | (0.0308)** |
| | [0.0285] | [0.0681]* | [0.0418] |
| State Level ME - Centralized | -0.1734 | 0.2602 | 0.2028 |
| | (0.0482)*** | (0.1183)** | (0.0636)*** |
| | [0.0693]** | [0.1975] | [0.0909]** |
| State Level ME - Coroner State | -0.0079 | 0.0449 | 0.0131 |
| | (0.0380) | (0.0434) | (0.0452) |
| | [0.0500] | [0.1140] | [0.0794] |
| Observations | 1,749 | 1,749 | 1,749 |
| Number of fips | 45 | 45 | 45 |
| Control Variables | Yes | Yes | Yes |
| State FE | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes |

*** p<0.01, ** p<0.05, * p<0.1 Robust standard errors clustered by state are in parentheses. Bootstrapped standard errors cluster by state are in brackets. Control variables include percent White, percent Black, percent Female, percent with College Education, percent with High School Education, percent under 5 years old, percent between 5-17 years old, percent greater than 64 years old, log state population, log state income per capita, percent married, percent separated, percent widowed, and percent divorced. The exposure variable is total violent deaths among the Black population.

Table 12: Poisson Regression: Suicide Rate by Firearm Use

| | (1) | (2) |
|---|---|---|
| VARIABLES | Suicide w/o Firearms | Suicide w/ Firearms |
| Pct of Pop. Covered by ME | 0.0141 | 0.0907 |
| | (0.0864) | (0.0431)** |
| | [0.1136] | [0.0668] |
| Coroner Required Training | 0.0044 | -0.0443 |
| | (0.0326) | (0.0183)** |
| | [0.0478] | [0.0252]* |
| State Level ME - Centralized | 0.2478 | 0.0948 |
| | (0.0923)*** | (0.0553)* |
| | [0.1098]** | [0.0659] |
| State Level ME - Coroner State | 0.1795 | 0.0205 |
| | (0.0587)*** | (0.0348) |
| | [0.0816]** | [0.0486] |
| Observations | 2,433 | 2,326 |
| Number of fips | 50 | 50 |
| Control Variables | Yes | Yes |
| State FE | Yes | Yes |
| Year FE | Yes | Yes |

*** p<0.01, ** p<0.05, * p<0.1 Robust standard errors clustered by state are in parentheses. Bootstrapped standard errors cluster by state are in brackets. Control variables include percent White, percent Black, percent Female, percent with College Education, percent with High School Education, percent under 5 years old, percent between 5-17 years old, percent greater than 64 years old, log state population, log state income per capita, percent married, percent separated, percent widowed, and percent divorced. The exposure variable is non-firearm violent deaths in column 1 and firearm deaths in column 2.

Table 13: Rate of Death Type by Total Violent Deaths controlling for Unemployment

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| VARIABLES | Accidents | Suicide | Homicide | Autopsy |
| Unemployment Rate | -0.0040 | 0.0172 | -0.0092 | 0.0130 |
| | (0.0014)*** | (0.0036)*** | (0.0079) | (0.0077)* |
| | [0.0016]** | [0.0039]*** | [0.0081] | [0.0086] |
| Pct of Pop. Covered by ME | -0.0199 | 0.0492 | 0.0188 | -0.1316 |
| | (0.0251) | (0.0793) | (0.0756) | (0.1981) |
| | [0.0515] | [0.1357] | [0.1674] | [0.3915] |
| Coroner Required Training | -0.0127 | -0.0148 | 0.0943 | -0.0461 |
| | (0.0071)* | (0.0161) | (0.0282)*** | (0.0615) |
| | [0.0085] | [0.0229] | [0.0378]*** | [0.0870] |
| State Level ME - Centralized | -0.0721 | 0.1838 | 0.1895 | -0.0119 |
| | (0.0381)* | (0.1156) | (0.0675)*** | (0.2031) |
| | [0.0544] | [0.1415] | [0.1123]* | [0.2883] |
| State Level ME - Coroner State | -0.0240 | 0.0691 | 0.0084 | 0.1325 |
| | (0.0133)* | (0.0293)** | (0.0508) | (0.0670)** |
| | [0.0226] | [0.0429] | [0.0932] | [0.1200] |
| Observations | 2,033 | 2,033 | 2,033 | 1,589 |
| Number of fips | 50 | 50 | 50 | 50 |
| Control Variables | Yes | Yes | Yes | Yes |
| State FE | Yes | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes |

*** p<0.01, ** p<0.05, * p<0.1 Robust standard errors clustered by state are in parentheses. Bootstrapped standard errors cluster by state are in brackets. Control variables include percent White, percent Black, percent Female, percent with College Education, percent with High School Education, percent under 5 years old, percent between 5-17 years old, percent greater than 64 years old, log state population, log state income per capita, percent married, percent separated, percent widowed, and percent divorced. The exposure variable is total violent deaths.

Table 14: Poisson Regression: Rate of Death Type by Total Violent Deaths

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| VARIABLES | Accidents | Suicide | Murder | Autopsy |
| Pct of Pop. Covered by ME | -0.0014 | 0.0540 | -0.1209 | -0.0907 |
| | (0.0146) | (0.0489) | (0.0794) | (0.1008) |
| Coroner Required Training | -0.0055 | -0.0227 | 0.0841** | -0.0237 |
| | (0.0083) | (0.0193) | (0.0401) | (0.0641) |
| State Level ME - Centralized | -0.0246 | 0.1787*** | -0.0594 | 0.0853 |
| | (0.0223) | (0.0660) | (0.0863) | (0.1046) |
| State Level ME - Coroner State | -0.0275** | 0.0847*** | 0.0432 | 0.1303** |
| | (0.0134) | (0.0320) | (0.0682) | (0.0617) |
| Observations | 2,450 | 2,450 | 2,450 | 1,800 |
| Number of fips | 50 | 50 | 50 | 50 |
| Control Variables | Yes | Yes | Yes | Yes |
| State FE | Yes | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes |

*** p<0.01, ** p<0.05, * p<0.1 Robust standard errors clustered by state are in parentheses. Bootstrapped standard errors cluster by state are in brackets. Control variables include percent White, percent Black, percent Female, percent with College Education, percent with High School Education, percent under 5 years old, percent between 5-17 years old, percent greater than 64 years old, log state population, log state income per capita, percent married, percent separated, percent widowed, and percent divorced. The exposure variable is total violent deaths. Total violent deaths sums up the total number of accidents and suicides reported by the CDC as well as the total number of murders reported by the FBI Uniform Crime Reports.

# 7 Figures

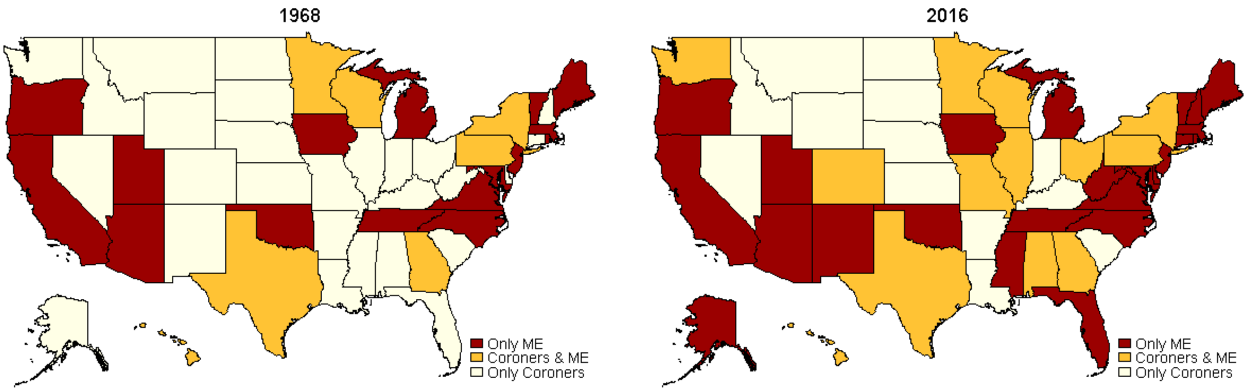


Figure 1: Coroners and Medical Examiners Systems in the US

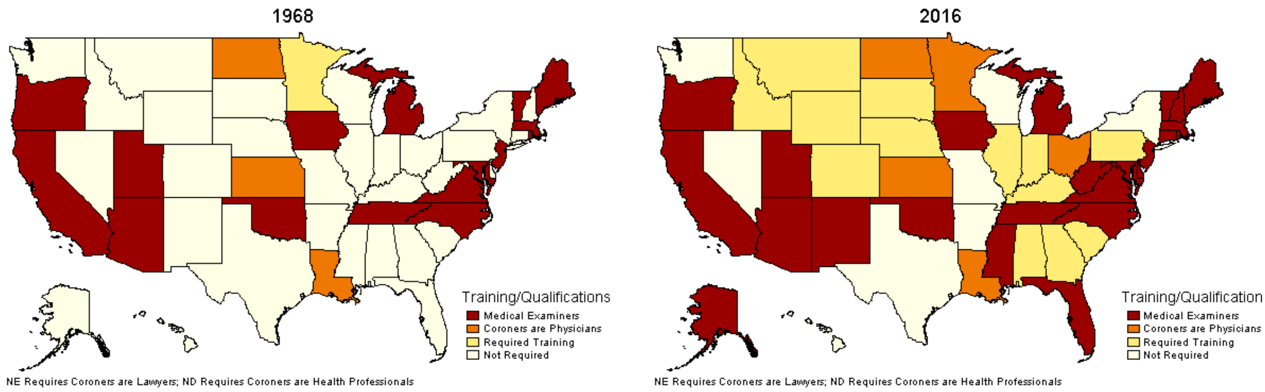


Figure 2: Training Requirements for Coroners by State

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