# COVID-19 Mortality and the End of the Public Health Emergency*

## Role of County Death Investigation Systems

Saloni Bhogale† Raeven Faye Chandler‡ Malia Jones§

July 2025

**Abstract**

Does declaration of the public health emergency matter for reporting of COVID-19 deaths, and does this vary by the death reporting system in place at the county level? While the COVID-19 public health emergency was active, deaths due to COVID-19 were required to be investigated in some states. However, the declaration ended this requirement. We combine county-level restricted data on COVID-19 mortality and jurisdictional information on medico-legal systems that determined whether deaths required to be investigated by the medico-legal investigating officers (typically, coroners or medical examiners). Our findings suggest that the declaration that ended the public health emergency *reduced* the number of deaths reported whose main cause of death was attributed to COVID-19. We also find that the decrease in death reporting is mainly in counties which have medical examiners, suggesting that the type and manner of death investigation carried out by different medico-legal officers influenced the COVID-19 mortality statistics.

Word count: 4648

*This material is based upon work support by the National Institute of Food and Agriculture, United States Department of Agriculture, Hatch Project 7007986. This research was certified exempt from human subjects oversight by the Minimal Risk Research Institutional Review Board of [redacted for blind review] on May 7, 2025

†Ph.D. Candidate, Department of Political Science, University of Wisconsin–Madison, bhogale@wisc.edu

‡Demographic Program Manager, Applied Population Lab, University of Wisconsin–Madison, rchandler34@wisc.edu

§Assistant Professor, Department of Community and Environmental Sociology, University of Wisconsin–Madison, malia.jones@wisc.edu

# 1 Introduction

Mortality statistics are the bedrock of public health research and practice: they are essential for public health surveillance and research on the effectiveness of interventions. Accurate information on deaths is also essential to conduct civil and criminal investigations. The quality of these statistics becomes even more important during a public health crisis like the COVID-19 pandemic, to measure the pandemic's effect on the population and shaping public health agencies' response.

A crucial part of such statistics is identifying the cause of death. Across US counties, a variety of personnel positions play key roles in death investigations and certifications: physicians, nurses, lawyers, law enforcement personnel, and funeral directors. The most important among them is the role of coroners and medical examiners – officials who are tasked with determining the cause and manner of deaths, called the "medical certification of deaths" (Jentzen 2010). Depending on the circumstances of the death and jurisdictional rules, deaths may need to be *investigated* and *certified* by a medico-legal officer – the officer is tasked with conducting a thorough investigation and completing the medical certification of the cause of death[1].

A complete death investigation involves several decisions about what evidence is necessary and appropriate, and may include physical examination of the deceased, autopsy, X-ray, toxicology, or other laboratory tests[2]. Further, officers record a death certificate, which provides important personal information about the decedent and about the circumstances and cause of death, which forms the source of national mortality statistics[3]. The details in the certification process provide information of the sequence in which different causes led to the death, that includes the immediate cause of death, the chain of events/conditions leading to the death, and finally, the underlying cause of death (UCOD).

States and local level jurisdictions have their own systems for conducting death investigations and certification, carried out by medico-legal officers. Like much of public health practice

[1] Medical Examiners' and Coroners' Handbook on Death Registration and Fetal Death Reporting, National Center for Health Statistics, Centers for Disease Control and Prevention, April 2003, https://www.cdc.gov/nchs/data/misc/hb_me.pdf

[2] Medico-legal Death Investigation System: Workshop Summary, National Academies Press, 2003, http://www.nap.edu/catalog/10792

[3] *Ibid*

in the US, responsibility for legislating the roles, functions, qualifications and appointment methods of the medico-legal death investigation (MDI) system resides at the state level, and practices vary significantly across US states and counties (Jentzen 2010). The MDI in each county is determined at the state level for some states, and the county level for others, and the responsibility of conducting such an investigation can fall under the purview of coroners, medical examiners, or other types of county officials. Some states also have a 'State Medical Examiner', which typically provides oversight and standardization to county-level MDIs. Coroners are typically elected county officers and may or may not have any training specific to medicine or pathology (varies by jurisdictions), while medical examiners are mostly physicians.

There is variation in what types of deaths must be investigated and certified by MDI officers, rather than simply certified by an attending physician or funeral director. 28 states require that deaths that may constitute a threat to public health should be investigated and certified by MDI officers, while 22 states have no such requirement. While the COVID-19 pandemic was formally a public health emergency, all COVID-19 associated deaths were required to be investigated and certified by the local MDI officer in all jurisdictions within the 28 states with that requirement. On May 11, 2023, the United States declared the COVID-19 public health emergency to have ended. After that date, COVID-19 associated deaths were no longer required to have investigations and certifications by MDI officers. In the 22 states where no such investigation requirement exists, the end of the PHE should have had no impact on death reporting practices on the ground.

Typically, deaths due to COVID-19 should have COVID-19 listed as a UCOD; however, common problems in certifying deaths due to COVID-19 involve reporting an intermediate cause as the UCOD, as opposed to the actual cause (COVID-19), which creates a lack of specificity or illogical sequences[4]. The Centers for Disease Control and Prevention (CDC) explains this in their guidelines:

> "For example, pneumonia is an intermediate cause of death since it can be caused

[4]Vital Statistics Reporting Guidance, Report No. 3, April 2020-February 2023, https://www.cdc.gov/nchs/data/nvss/vsrg/vsrg03-508.pdf

> by a variety of infectious agents or by inhaling a liquid or chemical. Pneumonia is important to report in a cause-of-death statement, but generally, it is not the UCOD. The cause of pneumonia, such as COVID-19, needs to be stated on the lowest line [the underlying cause of death]"

Importantly, according to the CDC, the UCOD on the death certificate represents "a medical opinion that might vary among individual medical-legal officers". This opinion can be influenced in at least two ways: first, conducting an investigation can inform this opinion by adding relevant information about the events leading to death and second, by the training or expertise of the individual who finally determines of the cause of death which varies depending on whether the certifier is a physician, coroner or medical examiner.

A challenge in estimating the causal effect of various MDI systems on COVID-19 death reporting is that the type of officer in each county is fixed and does not typically change over time. There may be several sources of unmeasured confounding in a simple analysis comparing county-level death reporting and types of officers, such as health behaviors, vaccination levels and the quality of public health systems.

To overcome this issue, we take advantage of a unique policy change in the US. On May 11, 2023, the United States announced the 'End of the Federal COVID-19 Public Health Emergency (PHE) Declaration'[5]. O Leveraging the policy change and a difference-in-differences design, we are able to robustly study the effect of changes in the application of the death certification policy on COVID-19 death reporting.

In this study, we address two research questions: 1. What is the effect of removing a policy that requires MDI officers to conduct death investigation and certification on COVID-19 death reporting?, and 2. Does the effect of removing such a policy on COVID-19 death reporting vary with the type of MDI officer? We address these questions in this paper using county-level data on the medico-legal systems and monthly data on COVID-19 deaths.

[5]Archived page at this link: https://archive.cdc.gov/www_cdc_gov/coronavirus/2019-ncov/your-health/end-of-phe.html#:~:text=May%2011%2C%202023%2C%20marks%20the,to%20the%20COVID-19%2D19%20pandemic.

# 2 Data Sources

We rely on four sources of data. First, we use detailed county-level cause of death data from the CDC National Center for Health Statistics, for each month from X to X. Data includes the underlying cause of death and the 'exact date of the vital event'. These two pieces help us identify COVID-19 cases (by using the code U07.1 for COVID-19 underlying cause of death) as well as the month of death.

Second, expected mortality is estimated for each county-month-year combination, following the approach in Paglino et al. (2023), who leverage a Bayesian Hierarchical Spatial Model to estimate expected mortality for 3127 counties for each month from March 2020 to February 2022. We extend this work for two additional years by predicting expected mortality up to February 2024. This allows us to obtain estimates of excess mortality for each county and each month, and on subtracting the reported COVID-19 deaths, we obtain the number of non-COVID-19 excess deaths in each county.

We combined this data with two more sources. First, we assemble data on the medico-legal death investigation (MDI) system practiced in each county, obtained from the Center for Disease and Controls' website[6]. Based on data assembled from the CDC, we see about 1146 counties (36.5%) have MEs and 1544 counties (49.1) have Coroners. The rest 14.4% counties have other county officials, like the sheriff, county attorney or 'Justice of the Peace' serving as the MDI officer. While coroners typically do not have a background in pathology, medical examiners have varying educational backgrounds in medicine (Ruiz et al. 2018). We augment this dataset by adding data on 2023 County Health Rankings[7] that allow us to measure important baseline measures and indicators of health and health capacity before the policy change.

Finally, we use wastewater data from the National Wastewater Surveillance System. Each row indicates data from a sampling location over fifteen days, obtained from a wastewater treatment plant. Each plant is mapped to one or more counties and captures the proportion

[6]Link here: https://www.cdc.gov/comec/state-mec-organizations/index.html

[7]County Health Rankings & Roadmaps, University of Wisconsin Population Health Institute. 2023. www.countyhealthrankings.org

of tests with SARS-CoV-2 detected. We use county-level 'FIPS' codes to merge these four datasets to conduct the main and supplementary analyses.

# 3 Measurement

Throughout the pandemic, the National Center for Health Statistics' (NCHS's) National Vital Statistics System (NVSS) collected official death certificate data. Since our main outcome concerns the reporting of the underlying cause of death, we outline details of how exactly the process operates at the local level.

The death certificate is composed of two parts: the medical portion (typically filled out by the physician, and in the case of an investigation, also the medical examiner or coroner), and the non-medical part (filed out by the funeral director). The medical portion includes the 'certification' of death which consists of two steps: first, the causes and classifications of death need to be determined, and second, these need to be 'signed', thereby certifying the death certificate (Ruiz et al. 2018).

The certifier reports information about a decedent's death, including the place, time, manner, and cause of death (Ahmad et al. 2021). Certifiers use their best medical judgment based on available information in providing cause-of-death information. Lab confirmations are encouraged but not required. The death records are compiled and reported by counties to the vital records offices at the state and then national level, where further coding, review, and analysis are conducted before the data are released publicly.

Deaths are recorded only once they are reported. Factors like limited local capacity and shortage of trained personnel can lead to mis-classifications and under-reporting of deaths due to specific causes. This phenomenon has been observed in cancer mortality statistics (German et al. 2011), infection-related deaths (Govindan et al. 2014), mortality due to Alzheimer disease (James et al. 2014), death certification errors and inaccuracies (McGivern et al. 2017; Flanders 1992; Moriyama 1989; Maudsley and Williams 1996), inaccuracies in cause of death and discordance among reviewers (Hoffman et al. 2018; Reddy et al. 2023; Spreco et al. 2023). On the other hand, death certificates are very accurate (over 99%) at

correctly reporting deaths by suicide[8]

All analyses were conducted in R (Version 4.4.1). This research was certified exempt from human subjects oversight by the Minimal Risk Research Institutional Review Board of [redacted for blind review] on May 7, 2025.

# 4 Descriptive Statistics

We first start by producing simple descriptive statistics for the full sample of counties, and for the two groups – counties that required deaths related to the public health emergency to be investigated and counties that did not have this requirement. There is a wide variety of counties in the treatment group, spanning large, diverse states like California and predominantly rural states like Wyoming.

# 5 Empirical Strategy

The main objective of this paper is to estimate the effect of the end of the Federal COVID-19 Public Health Emergency (PHE) on COVID-19 death reporting in jurisdictions that require referring deaths that involve threats to public health to the medical examiner or coroner for investigation. To do so, we leverage a difference-in-differences design as follows:

$$Y_{ct} = \beta_0 + \beta_1 \cdot \text{Post}_t + \beta_2 \cdot \text{Treat}_c + \beta_3 \cdot (\text{Post}_t \times \text{Treat}_c) + \epsilon_{ct}$$

where $Y_{ct}$ denotes the number of COVID-19 deaths per 100,000 in county $c$ at time $t$. $Treat_c$ indicates whether the county requires referring COVID-19 deaths to the death investigating officers, $Post_t$ is an indicator that takes the value 1 for each observation during and after May 2024. The errors $\epsilon_{ct}$ are clustered at the county level.

For the validity of this design, we invoke two assumptions. First, that the treatment

[8]Miland Ned Palmer, Accuracy of Death Certificate Data in Reporting Suicide in the United States, PhD Thesis, Walden University

Table 1: Descriptive statistics

| Variable Name | Not-Investigating Counties | Investigating Counties | Difference | t-test *p-val* | Units |
|---|---|---|---|---|---|
| Poor or Fair Health | 0.16 | 0.16 | 0.00 | 0.24 | Percent |
| Excessive Drinking | 0.19 | 0.19 | 0.00 | 0.12 | Percent |
| Uninsured | 0.12 | 0.12 | 0.00 | 0.52 | Percent |
| Primary Care Physicians | 0.00 | 0.00 | 0.00 | 0.02 | Count per 100,000 |
| Ratio of Population to Physicians | 2744.58 | 2603.75 | -140.83 | 0.12 | Ratio |
| Flu Vaccinations | 0.45 | 0.44 | -0.01 | 0.00 | Percent |
| High School Graduates | 0.89 | 0.89 | 0.00 | 0.80 | Percent |
| Unemployment | 0.04 | 0.05 | 0.00 | 0.00 | Percent |
| Income Inequality | 4.50 | 4.57 | 0.07 | 0.02 | Ratio (80/20) |
| Social Associations | 11.71 | 10.60 | -1.11 | 0.00 | Count per 10,000 |
| Drug Overdose Deaths | 24.06 | 26.16 | 2.10 | 0.00 | Count per 100,000 |
| Uninsured (Adults under 65) | 0.14 | 0.14 | 0.00 | 0.85 | Percent |
| Median Household Income | 59362.31 | 58327.83 | -1034.48 | 0.06 | USD |
| Population | 94135.90 | 122795.14 | 28659.23 | 0.03 | Count |
| Percent older than 65 | 0.20 | 0.20 | 0.00 | 0.25 | Percent |
| Percent Rural | 0.59 | 0.58 | -0.01 | 0.50 | Percent |

*Note*: $^{*}$p<0.1; $^{**}$p<0.05; $^{***}$p<0.01. We take the means of observations for the two groups of counties: those that do not have a requirement to conduct death investigations for COVID-19 deaths, and those which do. The units column indicates the units of a measure: they are typically in percent, or counts per 100,000. All variables are measured based on data from the 2023 County Health Rankings Data. We observe that the differences in some variables are statistically significant (for e.g. the number of primary care physicians, percent of flue vaccination, percent of graduates, count of social associations, drug overdose deaths and population per county. However, for each of these variabels, the differences are subsantively small.

jurisdictions would have evolved in a similar pattern as the control jurisdictions, if the policy had not been in place. Second, we invoke a no-anticipation assumption. Although the CDC had been working with local territories to prepare for the end of the PHE declaration, these changes did not affect the death investigation and certification processes before the announcement was made[9] [10].

# 6 Limitations

We acknowledge three limitations in our analysis. First, while two of our three main outcomes are defined for all counties, data from wastewater is collected only for 802 counties, making up only about 25% of the total counties. Thus, the estimates for the wastewater analysis should be interpreted with caution due to the limitations of the data. Second, in our Appendix we document considerable variation in the types, backgrounds, and selection modalities of the MDI system. Only 8 out of the 30 states with coroners require the coroner to be a doctor or physician–the other either do not specify the background, or require only a high school diploma with minimal training. Moreover, 20 out of these 30 states conduct elections for coroners, so we cannot say for sure whether the elections or expertise are the main drivers of the differences in effects observed. Finally, expected mortality is based on predictions from prior trends, and is sensitive to the mortality trends in the period being used to predict into the future. Using a different reference period may lead to different expected mortality estimates (related limitations further discussed in Helleringer and Queiroz 2022).

# 7 Discussion

## 7.1 Descriptive Evidence

In this section, we provide descriptive results on the effect of declaring the end of the public health emergency had on the monthly variation in COVID-19 deaths per capita, as displayed

[9] COVID-19 Surveillance After Expiration of the Public Health Emergency Declaration — United States, May 11, 2023, May 12, 2023, Vol. 72, No. 19, Morbidity and Mortality Weekly Report

[10] Correlations and Timeliness of COVID-19 Surveillance Data Sources and Indicators — United States, October 1, 2020–March 22, 2023, May 12, 2023, Vol. 72, No. 19, Morbidity and Mortality Weekly Report

in the following figures. We first distinguish based on counties that required death reporting to be investigated by MDI officers, as seen in Figure 1. In Figure 2, we show the geographic variation in death reporting across counties in the United States.

In Figure 1 we see that the trends of COVID-19 deaths look very different before and after the end of the public health emergency was announced. There are changes in peaks and trends for counties across the two groups in the pre-treatment period. Interestingly, we see a reversal during the month of the policy change, following which the two groups of counties exhibit similar trends.

While there appears to be a considerable heterogeneity in trends in the period before the announcement, the trends in the two groups after the announcement are much more in tandem.

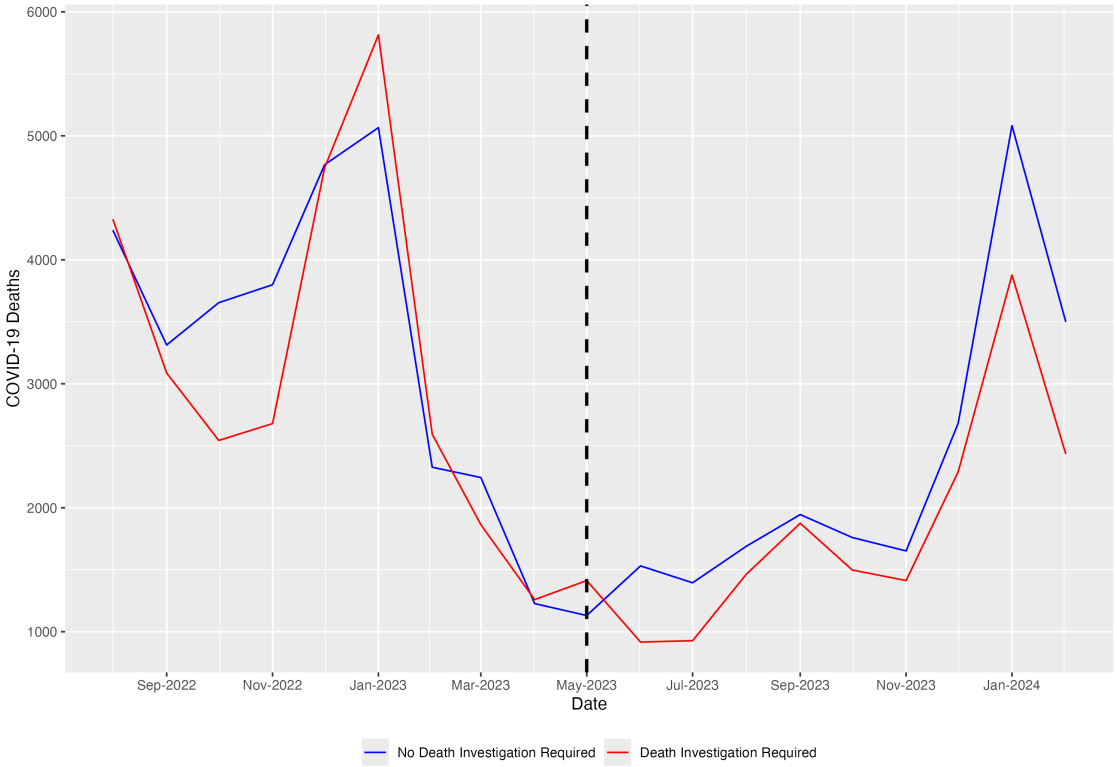
Figure 2 illustrates the geographic variation in death investigation systems. While the MDI system in some states is determined entirely at the state level (for eg. see Kansas, Colorado), we can see that the MDI system varies considerably across counties in Texas, California and Washington. Overall, 1544 counties have coroners, 1146 counties have medical examiners, and 453 counties have another county official–a sheriff, a county attorney or a 'Justice of the Peace'.

## 7.2 Main Findings

Our main analysis examines the effect of the end of the public health emergency on COVID-19 attributed mortality. During the PHE, in 28 states, deaths related to COVID-19 required investigation by the local MDI officer. At the end of the emergency, this requirement no longer applied.

We start by estimating the average treatment effect on the treated (the ATT) from the difference-in-differences design, by estimating the parameters in Eq (1), on both COVID-19 and non-COVID-19 excess deaths (NCEDs). We find that declaring the end of the COVID-19 Public Health Emergency decreased the reported COVID-19 cases by 30%. However, we do not see a similar decrease in estimated excess deaths for these states–in fact, it appears that

Figure 1: Monthly COVID-19 mortality by jurisdictional death investigation requirements




*Notes*: No Death Investigation Required are counties wherein MDI officers are not required to investigate deaths that may threaten public health. Death Investigation Required are counties wherein MDI officers are referred to since COVID-19 deaths threaten overall public health. Data spans eight months before and after declaring the end of the public health emergency. Y-axis shows the sum of COVID-19 mortality for all counties within each group. Data imputed for counties where mortality data was not available due to censoring.

the overall excess deaths increased by 16% during this period.

For robustness, we analyse treatment effects for two additional outcomes: an estimate of non-COVID-19 excess mortality at the county level and for the percent of tests from wastewater sampled from 543 counties. We find an increase in non-COVID-19 excess mortality at the county level following the end of the PHE. This is to be expected, since given no change in total deaths – a decrease in COVID-19 death reporting would lead to an increase in reporting deaths in other categories. Here, we assume that there is no change in the actual deaths due to COVID-19 in these periods. While we cannot directly measure the number of actual COVID-19 deaths in each county, we can show that there was a modest (2.7%) *increase* in the prevalence of SARS-CoV-2 in the wastewater surveillance system. This provides some additional confidence that the decrease in COVID-19 deaths reported is really due to the

Figure 2: Geographic variation in death investigation system

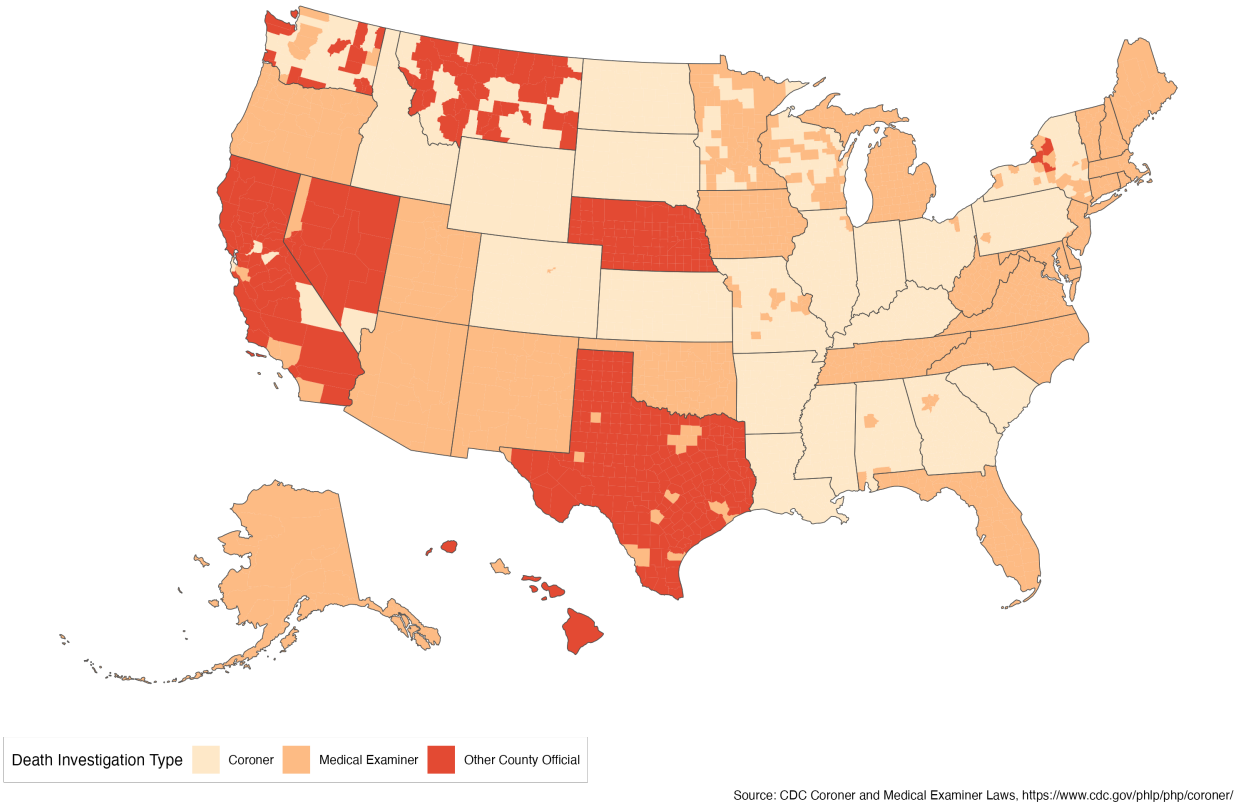



Table 2: Declaring end of COVID-19 Public Health Emergency and mortality

| | *Dependent variable:* | | |
|---|---|---|---|
| | COVID-19 Mortality | NCEDs | Wastewater Tests |
| ATT | −0.50*** | 1.20*** | 2.68*** |
| | (0.04) | (0.42) | (0.17) |
| Mean | 1.63 | 6.31 | 96.26 |
| Observations | 59,356 | 59,356 | 283,031 |
| $R^2$ | 0.02 | 0.001 | 0.02 |

*Note*: *p<0.1; **p<0.05; ***p<0.01. Standard errors in paranthesis clustered at the county level. The table reports estimates from Eq (1) using monthly mortality between August, 2022 and February, 2024. 'Wastewater Tests' is a measurement from the wastewater surveillance system, indicating the proportion of tests with SARS-CoV-2 detected. Data concerns 3124 US counties over 19 months for COVID-19 Mortality and NCEDs, and 453 US Counties over 19 months for Wastewater Tests

change in reporting requirements and practices of death reporting on the ground, and not due to an decrease in COVID-19 during this period.

The CDC has pointed to the high accuracy of identifying deaths related to COVID-19 from death certificates which listed COVID-19 as the underlying cause of death (given by the ICD-10 code for COVID-19) on the account of plausible chain-of-event conditions. Our results point to a possible under-reporting of such deaths after the end of the PHE declaration, pointing to the important role played by the MDI officers in death reporting.

## 7.3 Mechanisms

To help understand the drivers of the decrease in COVID-19 death reporting, we re-estimate the models by including interactions with the MDI officer type (coroner, medical examiner, or other) for each county to examine differential impacts of the announcement across counties.

In order to look at treatment effect heterogeneity based on the type of MDI officer, we limit our analysis to 2,671 counties that had either a coroner or a medical examiner. The remaining 453 counties have MDI officers with a wide variety of titles and qualifications, making analysis of them as a group non-informative. We create a binary variable for each county, that indicates that the officer is a coroner, denoted by $\text{Coroner}_c$). We interact this binary variable in order to obtain an estimate of heterogeneous treatment effect: that is, whether and by how much the treatment effect is different if the county had a coroner as the MDI officer. We do this by estimating the following equation:

$$\begin{aligned} Y_{ct} = \beta_0 &+ \beta_1 \cdot \text{Post}_t + \beta_2 \cdot \text{Treat}_c + \beta_3 \cdot (\text{Post}_t \times \text{Treat}_c) \\ &+ \beta_4 \cdot \text{Coroner}_c + \beta_5 \cdot (\text{Post}_t \times \text{Coroner}_c) + \beta_6 \cdot (\text{Treat}_c \times \text{Coroner}_c) \\ &+ \beta_7 \cdot (\text{Post}_t \times \text{Treat}_c \times \text{Coroner}_c) + \epsilon_{ct} \end{aligned}$$

We interpret $\beta_7$ to get the heterogeneous treatment effect for counties with coroners. We first look at COVID-19 death reporting and find that after the announcement, if the MDI

officer in a county was a coroner, the effect of ending the PHE is much smaller – in fact, COVID-19 death reporting in these counties increases by 40%. This can happen if the work carried out by coroners is very different from the work carried out by physicians–in the post-announcement period, coroners would not be required to conduct the investigation and certify the deaths. Additional research could attempt to disentangle the detailed mechanism driving this phenomenon.

Table 3: Heterogeneous effects of declaring end of COVID-19 PHE based on MDI officer type

| | *Dependent variable:* | |
|---|---|---|
| | COVID-19 Mortality | NCEDs |
| ATT (Medical Examiner) | $-0.70^{***}$ | 0.42 |
| | (0.07) | (0.67) |
| ATT (Coroner) | $0.65^{***}$ | 1.35 |
| | (0.09) | (0.90) |
| Mean | 1.63 | 6.31 |
| Observations | 50,749 | 50,749 |
| $R^2$ | 0.02 | 0.002 |

*Note*: $^{*}$p<0.1; $^{**}$p<0.05; $^{***}$p<0.01. Standard errors in paranthesis clustered at the county level. The table reports estimates from Eq (1) using monthly mortality between August, 2022 and February, 2024, adding interactions with MDI officer categories. Data covers 2671 counties which had either coroners or medical examiners, over 19 months.

However, if the MDI officer in a county was a medical examiner, the end of a PHE reduces COVID-19 death reporting by almost 43%. This large effect for counties with MEs implies that the conduct of these MDI officer were different from that of coroners, and the end of the PHE affected the two types of MDI officers very differently. The coefficients for both groups are statistically differentiable through a Wald test (p-value smaller than $2 * 10^{-16}$). In addition, the difference in effect size implies that there is a deviation in the extent to which the two types of MDI officers assess the same phenomenon, implying the lack of consistency and agreement between the types of investigators. Gill and DeJoseph (2020) provides an instance of this through a case–the investigation carried out by a medical examiner resulted in additional laboratory testing and a revised death certificate for a woman for whom the earlier cause of death certified by the physician merely mentioned “acute respiratory failure”,

pointing to the possible expertise of medical examiners in correctly certifying deaths.

# 8 Conclusion

The unprecedented nature of the COVID-19 pandemic has led public health researchers and officials to reconsider the quality of mortality surveillance and death reporting, given its crucial role in guiding key decisions of officials, public health practitioners, and other stakeholders[11]. The first stage of mortality surveillance is through cause-of-death reported through the death certification process. Prior research has shown that there is considerable heterogeneity in cause of death reporting across diverse case types. Through this paper, we demonstrate variation in cause-of-death reporting in COVID-19 due to policy factors managed at the state level, including whether deaths must be investigated and the type of officer in charge of certifying cause of death (coroners, medical examiners, and other officers).

We use county-level data on COVID-19 death reporting and use a point-in-time policy intervention–the announcement of the end of the public health emergency – to estimate the effects on COVID-19 mortality reporting. Since some jurisdictions required deaths that constitute a risk to public health to be investigated by the MDI officer during the pandemic, the announcement potentially meant a change in on-the-ground practices in cause of death reporting.

The findings have two major implications. First, researchers must be careful in using deaths reported due to COVID-19 as actual deaths due to COVID-19, and find ways to account for common problems in cause-of-death certifications, especially considering how policy changes can affect death reporting on the ground. Second, a strong avenue for future research is to explain the reasons driving the lack of agreement between different death certifiers. While medical opinions can vary across actors due to variations in training, the considerable differences in the mode of selection and backgrounds of MDI officers point to a need for standardization to minimize inconsistencies.

[11]Vital Statistics Reporting Guidance, Report No. 3, April 2020-February 2023, https://www.cdc.gov/nchs/data/nvss/vsrg/vsrg03-508.pdf

# References


Ahmad, Farida B., Robert N. Anderson, Karen Knight, Lauren M. Rossen, and Paul D. Sutton. 2021. "Advancements in the National Vital Statistics System to Meet the Real-Time Data Needs of a Pandemic." *American Journal of Public Health* 111 (12): 2133–40. https://doi.org/10.2105/ajph.2021.306519.

Flanders, W Dana. 1992. "Inaccuracies of Death Certificate Information." *Epidemiology* 3 (1): 3–5. https://doi.org/10.1097/00001648-199201000-00002.

German, Robert R., Aliza K. Fink, Melonie Heron, Sherri L. Stewart, Chris J. Johnson, Jack L. Finch, and Daixin Yin. 2011. "The Accuracy of Cancer Mortality Statistics Based on Death Certificates in the United States." *Cancer Epidemiology* 35 (2): 126–31. https://doi.org/10.1016/j.canep.2010.09.005.

Gill, James R., and Maura E. DeJoseph. 2020. "The Importance of Proper Death Certification During the COVID-19 Pandemic." *JAMA* 324 (1): 27. https://doi.org/10.1001/jama.2020.9536.

Govindan, Sushant, Letitia Shapiro, Kenneth M. Langa, and Theodore J. Iwashyna. 2014. "Death Certificates Underestimate Infections as Proximal Causes of Death in the U.S." Edited by Keitaro Matsuo. *PLoS ONE* 9 (5): e97714. https://doi.org/10.1371/journal.pone.0097714.

Helleringer, Stéphane, and Bernardo Lanza Queiroz. 2022. "Commentary: Measuring Excess Mortality Due to the COVID-19 Pandemic: Progress and Persistent Challenges." *International Journal of Epidemiology* 51 (1): 85–87. https://doi.org/10.1093/ije/dyab260.

Hoffman, Ryan A., Janani Venugopalan, Li Qu, Hang Wu, and May D. Wang. 2018. "Improving Validity of Cause of Death on Death Certificates." In *Proceedings of the 2018 ACM International Conference on Bioinformatics, Computational Biology, and Health Informatics*, 178–83. Washington DC USA: ACM. https://doi.org/10.1145/3233547.3233581.

James, Bryan D., Sue E. Leurgans, Liesi E. Hebert, Paul A. Scherr, Kristine Yaffe, and David A. Bennett. 2014. "Contribution of Alzheimer Disease to Mortality in the United States." *Neurology* 82 (12): 1045–50. https://doi.org/10.1212/wnl.0000000000000240.

Jentzen, Jeffrey M. 2010. *Death Investigation in America: Coroners, Medical Examiners, and the Pursuit of Medical Certainty*. Cambridge: Harvard University Press.

Maudsley, G., and E. M. I. Williams. 1996. "'Inaccuracy' in Death Certification - Where Are We Now?" *Journal of Public Health* 18 (1): 59–66. https://doi.org/10.1093/oxfordjournals.pubmed.a024463.

McGivern, Lauri, Leanne Shulman, Jan K. Carney, Steven Shapiro, and Elizabeth Bundock. 2017. "Death Certification Errors and the Effect on Mortality Statistics." *Public Health Reports®* 132 (6): 669–75. https://doi.org/10.1177/0033354917736514.

Moriyama, I M. 1989. "Problems in Measurement of Accuracy of Cause-of-Death Statistics." *American Journal of Public Health* 79 (10): 1349–50. https://doi.org/10.2105/ajph.79.10.1349.

Paglino, Eugenio, Dielle J. Lundberg, Zhenwei Zhou, Joe A. Wasserman, Rafeya Raquib, Anneliese N. Luck, Katherine Hempstead, et al. 2023. "Monthly Excess Mortality Across Counties in the United States During the COVID-19 Pandemic, March 2020 to February 2022." *Science Advances* 9 (25): eadf9742. https://doi.org/10.1126/sciadv.adf9742.

Reddy, Dereddi Raja, John A. Cuenca, Joshua Botdorf, Mayoora Muthu, Ankit Hanmandlu, Robert Wegner, John Crommett, et al. 2023. "Clinical Characteristics and Cause of Death Among Hospitalized Decedents With Cancer and COVID-19." *Mayo Clinic Proceedings* 98 (3): 451–57. https://doi.org/10.1016/j.mayocp.2022.12.008.

Ruiz, Leah, Brianne M. Posey, Melanie-Angela Neuilly, Mary K. Stohr, and Craig Hemmens. 2018. "Certifying Death in the United States." *Journal of Forensic Sciences* 63 (4): 1138–45. https://doi.org/10.1111/1556-4029.13689.

Spreco, A., C. Andersson, R. Sjödahl, and T. Timpka. 2023. "Concordance Between COVID-19 Mortality Statistics Derived from Clinical Audit and Death Certificates in Östergötland County, Sweden." *Public Health* 221 (August): 46–49. https://doi.org/10.1016/j.puhe.2023.06.007.