Certificate-of-Need Laws and Healthcare Utilization during COVID-19 Pandemic

Sriparna Ghosh[1]
Agnitra Roy Choudhury[2]
Alicia Plemmons[3]

Abstract This paper investigates the impact of state-level Certificate-of-Need (CON) laws on COVID and non-COVID deaths in the United States during the SARS-CoV-2 pandemic. CON laws limit the expansion and acquisition of new medical services. The coronavirus pandemic created a surge in demand for medical services, which might be exacerbated in some states that have CON laws. Our investigation focuses on mortality due to COVID and non-COVID reasons, and in understanding how these laws affect access to healthcare for illnesses that might require similar medical equipment to COVID patients. Our baseline results suggest that mortality rates are higher in states with CON laws relative to that in states without CON laws. We also find that states with high healthcare utilization due to COVID that reformed their CON laws during the pandemic saw a reduction in mortality resulting from natural death, Septicemia, Diabetes, Chronic Lower Respiratory Disease, Influenza or Pneumonia, and Alzheimer's Disease in addition to reduction in COVID deaths.

I. Introduction

The COVID-19 pandemic has created an unparalleled and unprecedented stress test on the United States healthcare system. At the time of writing, hundreds of thousands of people have died of COVID and many hospitals have seen most beds filled at some point. We believe the true impact of COVID on U.S. mortality is understated and fails to account for additional non-COVID lives that have been lost due to resource constraints in bed space and medical intervention equipment such as respirators and ventilators. Prior to COVID, thirty-six states had Certificate-of-Need (CON) laws which restrict healthcare facility, equipment, and service expansions without government approval. We explore whether these legal

[1] Assistant Professor of Economics, Business & Economics Department, University of Cincinnati Blue Ash. Email: ghoshs7@ucmail.uc.edu; Office Phone: (513) 936-1680
[2] Visiting Assistant Professor, Department of Economics, Auburn University at Montgomery. Email: achoudhu@aum.edu; Office Phone: (334) 244-3505
[3] Assistant Professor of Economics, Department of Economics & Finance, Southern Illinois University Edwardsville. Email: aplemmo@siue.edu; Office Phone: (618) 650-3473

restrictions affect mortality rates due to COVID and non-COVID issues, and whether states that temporarily suspended or repealed their CON laws during the pandemic mitigated the effects, if any.

CON laws were initially enacted to prevent an oversupply of medical resources and improve access to healthcare facilities by individuals with socioeconomic challenges. They have since been defended as ways to increase charity, protect rural healthcare, and achieve supply-side cost controls for healthcare services. Unfortunately, these laws were not designed to prepare for healthcare demand surges such as what has been experienced during the recent pandemic.

The purpose of our study is to determine if CON laws, and their subsequent relaxation in some states, impacted the volume of deaths from non-COVID related illnesses. To do this, we combine mortality data collected through the CDC with state-level hospital and ICU bed utilization data to create a balanced panel mortality dataset for mid-March through the end of June 2020. Using both a difference-in-difference and a triple difference framework we observe time-series differences in mortality among states with varying CON laws. We observe differences in mortality rates for COVID, natural causes, Septicemia, Diabetes, Chronic Lower Respiratory Disease, Influenza or Pneumonia, and Alzheimer's Disease. These diseases are an interesting comparison group since common medical interventions for severe cases utilize similar equipment and resources.

We find that, when comparing reforming and nonreforming CON law states, that mortality in states with high hospital or ICU bed utilization for non-COVID related illnesses were substantial and significant. Indicating that, reforming states saw a decrease of lives lost to natural death (fifteen per 100,000 residents weekly), Septicemia, Diabetes, Chronic Lower Respiratory Disease, Influenza or Pneumonia, and Alzheimer's Disease (a combined two lives per 100,000 residents weekly). We also estimate that in states with high ICU bed utilization that subsequently reformed their CON laws to increase acquisitions of medical equipment, saved eleven lives per 100,000 residents from COVID weekly.

The paper proceeds as follows: Section II discusses the relevant literature on this topic and our contribution; Section III describes the data sources; Section IV outlines the methodology; Section V presents the empirical results; Section VI discusses the limitations and concludes.

II. Literature Review

Certificate-of-Need (CON) refers to a legal document required across the US for acquisitions, expansions, or creations of healthcare facilities[4]. With the introduction of CON laws in New York in 1964, several states started enacting their own versions of such regulations. With the introduction of National Health Planning and Resources Development Act of 1974 (later repealed in the 1980s), Federal Government began withholding funds from states that did not implement CON laws, giving the policy a further boost[5]. At the start of 2020, CON laws were implemented in 36 states and the District of Columbia (Mitchell et al., 2020). The Certificate of Need laws require health care providers to obtain permission from government entity or from competitors in the same market before purchasing any new equipment or extending a service. The goal of these regulations is to restrict the healthcare providers from overinvesting in facilities and services and to ensure easy access of health care services for the poor (Mitchell, 2016; Stratmann and Koopman, 2018).

Researchers have analyzed the impact of CON laws on several variables such as cost of care, access to health care, and quality of care delivered. CON laws have been justified as a cost control device (Rivers et al., 2007), a way to increase charity care (Mitchell et al., 2020), and as a mean of protection for rural health care (Stratmann and Koopman, 2018). Stratmann and Koopman (2018) investigate the effects of CON laws on rural health care and find that there are both more rural hospitals and more rural ambulatory surgical centers per capita in states without a CON program. Mitchell et al. (2020) conclude that these CON laws, even if well intentioned, have not resulted in higher-quality care.

CON laws allow medical providers a certain degree of market power, they restrict the hospital capacity to fewer hospital beds to raise prices leading to excess profits (Conover and Sloan, 1998; Stratmann

[4] The United States Department of Justice, retrieved from: https://www.justice.gov/atr/competition-health-care-and-certificates-need-joint-statement-antitrust-division-us-department, Accessed on July 22, 2020.

[5] National Health Planning and Resources Development Act of 1974, Pub. L. No. 93-641, 88 Stat. 2225 (1975) (codified at 42 U.S.C. §§ 300k–300n-5), repealed by Pub. L. No. 99-660, § 701, 100 Stat. 3799 (1986).

and Russ, 2014). This allows rural hospitals or hospitals in low socioeconomic areas to maintain market power and stay in business. Since CON laws restrict the number of hospitals and hospital beds (Bailey, 2018), during an emergency, enough hospital beds may not be available within a state.

As previously discussed, CON laws are associated with higher healthcare costs (Mitchell, 2016) and lower-quality healthcare (Stratmann and Wille, 2016). By studying the effect of CON laws on access to care, scholars have found that it leads to a) fewer hospitals per capita (Stratmann and Russ, 2014); b) fewer ambulatory surgery centers per capita (Stratmann and Koopman, 2018); c) fewer beds per capita (Stratmann and Koopman, 2018); d) fewer hospice care facilities (Stratmann and Russ, 2014); e) fewer dialysis clinics (Ford and Kaserman, 1993); f) fewer hospitals offering healthcare related services like MRI, CT, and PET scans (Stratmann and Baker, 2016); g) longer driving distances to obtain healthcare (Cutler et al., 2010); and h) racial disparities in the provision of healthcare (DeLia et al., 2009). Yet, this series of policies have maintained popularity, and were the regulatory norm in thirty-six states prior to the recent pandemic.

The hindrance created by CON laws have again come into focus as policymakers are struggling with how to respond to the spread of the COVID virus (Bayne et al., 2020; Haeffele et al., 2020). Mitchell (2020) suggests that during pandemic state, CON laws should be loosened to allow patients to quickly access healthcare. The literature on the effect of CON laws on mortality rates gives mixed results, with papers showing a negative impact of CON laws on mortality rates (Ho et al., 2009; Cutler et al., 2010), or no significant effect on mortality rates (Robinson et al., 2001; DiSesa et al., 2006; Popescu et al., 2006). A few studies have found that states with CON laws have increased mortality rates (Vaughan-Sarrazin et al., 2002; Popescu et al., 2006; Ho 2006; Stratmann and Wille, 2016). Stratmann and Wille (2016) find mortality rates among patients are higher in states those have adopted CON laws particularly from diseases like pneumonia, heart attacks, and heart failure. They further conclude that in states with stringent CON laws that there is a higher rate of readmission, leading to lower patient satisfaction. We seek to expand this discussion in under the unique stress test of pandemic policy reform to better understand the relationship between CON laws and mortality.

Most of the literature looks at mortality due to specific causes of death, particularly cardiovascular issues. Barley (2018) studies the association of states with CON laws on mortality by using a comprehensive, all-cause mortality dataset. He finds that CON laws do not reduce all-cause mortality rates. Our paper looks at how CON laws during a pandemic might impact mortality rates due to COVID and non-COVID causes for diseases that use similar medical interventions and equipment to COVID patients. This paper aims to contribute to the literature by exploring the potential bottleneck in healthcare service created by CON laws as healthcare services are reallocated towards COVID related healthcare services. We also contribute to the literature by investigating how the presence of CON laws exacerbate access problems to healthcare during pandemics.

III. Data Description

A. Mortality

Preliminary mortality data was provided through the Center for Disease Control. At the time of writing, these provisional death counts represent the most comprehensive and accurate data on lives lost. Death counts are aggregated weekly at the state level for deaths caused by: COVID, Natural Death, Septicemia, Diabetes, Chronic Lower Respiratory Disease, Influenza or Pneumonia, and Alzheimer's Disease. A description of all diseases and their common medical interventions for severe cases requiring hospitalization is available in Table 1. Natural Death is not included in the table, but the CDC definition is solely or almost entirely to disease or the aging process. This does not include homicide, suicide, or accidents. We focus on these types of deaths because severe cases of these diseases require overlapping types of medical equipment to COVID such as beds, respirators, and supplemental oxygen. Table 2 presents rough average means of deaths the week before states began implement CON law relaxations and the last week of complete data for all diseases (Septicemia does not have comprehensive data after the 22^{nd} week). We observe that the states that always maintained their CON laws did have lower average deaths, but their percentage increase in deaths between the sample periods was substantially higher in both the best- and worst-case scenarios.

The National Center for Health Statistics collects this data directly from completed death certificates reported by individual hospitals and states. Data within our sample begins in mid-March and ceases at the end of June. Currently, the acquired data contains approximately 1.5 million deaths, of which 132,366 involved COVID. These provisional death counts are incomplete and subject to change as states continue to report. If a specific cause of death killed between 1 and 10 people in a state within a weekly period, the CDC coded this as a null entry. In these cases, we have developed an upper and lower bound for all estimates by assuming that this represents one death in the best-case scenario, i.e., the lower bound, and nine in the worst-case scenario, i.e., the upper bound of our estimates.

B. Certificate-of-Need Laws

State-level certificate-of-need laws and legal changes were collected independently by the researchers based on governor executive orders pertaining to medical equipment acquisition. A list of the initial documents that started the CON law process are available in Table 3. Each state is different in their explanation of CON laws- some states use executive orders to either repeal, suspend, or increase the limit of the bed capacity high enough it is non-binding, while other states implement emergency policies that were already put into place prior to the pandemic. The third week was the most popular for implementing legislation. One important assumption that we make through our analysis is that the implementation of reforms was not driven by current utilization of hospital beds and ICU beds by COVID patients. This assumption is a limitation of our work that restricts our interpretation to correlative but only plausibly causal. Table 4 provides naive insight by regressing hospital capacity on reform implementation, along with state and week fixed effects, and we observe that there is no significant evidence of reforms being limited to only states with higher utilization of hospital services by COVID patients.

C. Hospital Capacity

Hospital capacity data was provided through the COVID-19 Burden Index developed through Torch Insight Healthcare Analytics from Levitt Partners which creates index files from base data updated daily through John Hopkins University. Data within our sample begins in mid-March and ends at the end of June. Though the data is available daily, we aggregate weekly values that align with the CDC Mortality data. Collected variables include hospital COVID cases, estimates of the upper and lower bound of hospital COVID cases, ICU COVID cases, estimates of the upper and lower bound of hospital COVID cases, total hospital bed capacity, total ICU bed capacity, hospital beds and ICU beds available for COVID. Using this information, we elicit both hospital and ICU bed utilization rates to determine available capacity for new patients in each of our weekly time periods. We use information on the hospital beds and ICU beds available for COVID patients, in a given state at a given time, to proxy for the utilization of health care services. We use the total hospital and ICU bed available to proxy for the supply of health care services.

IV. Methodology

We conduct three specifications to address the relationship between CON law reform and mortality. Our hypothesis is that states with high health care utilization due to COVID will see more access problems in states with CON laws than those without. Moreover, we hypothesize that states that relaxed their regulations might see an improvement in access and see a decline in mortality.

All the states in our analysis fall into one of three groups. Firstly, there are states that never had CON laws, called the *non-CON* states. Second, there are states that have CON laws and do not suspend them during the COVID pandemic, labelled as *CON* states. Finally, our treatment group comprises of states that relaxed their CON laws at some point of time between March and April to facilitate greater access to care during COVID. In our paper, we call these treated states *ReformCON* to reflect that these states had CON laws prior to COVID, but then decided to reform them at some point within our sample period. Initially, both non-CON states and CON states are used as control units. However, we use only the non-reforming CON law states as a control for our main specification. In our paper, we estimate three specifications.

$$y_{st} = \beta_0 + \beta_1(CON_s) + \beta_2(ReformCON_s) + \boldsymbol{\delta}(\boldsymbol{ReformCON_s * Post_t}) + \alpha_s + \mu_t + \varepsilon_{st} \quad (1)$$

The above equation is a baseline difference-in-difference model, capturing the effect of temporarily reforming CON laws on our mortality outcome variables. The variable *Post* captures exactly when each *ReformCON* state decides to suspend their CON laws. Since states relaxed the policy at different points in time, the exact timing of the policy change is plausibly exogenous. Thus, *Post* acts as a binary indicator that equals 1 after the individual state relaxed their CON law, and 0 otherwise. *Post* does not appear separately because there is not a proper counterfactual since the reforms were implemented over a series of weeks. To do this, we do assume that the decision to implement reforms are made independently. Since this is a strong assumption, it does restrict our ability to make casual inferences. State and time fixed effects are α_s and μ_t, respectively.

$$y_{st} = \beta_0 + \beta_1(ReformCON_s) + \boldsymbol{\delta}(\boldsymbol{ReformCON_s * Post_t}) + \alpha_s + \mu_t + \varepsilon_{st} \qquad (2)$$

We run another specification, with non-reforming CON law states (CON) as our control group. Specifications (2) and (1) are similar in structure with the exception that we drop non-CON states from the new specification and only observe reforming and non-reforming CON law states. Our outcome variables include mortality due to different causes of death, such as natural death, COVID related death, septicemia, diabetes, Alzheimer's, chronic lower respiratory disease, and influenza and pneumonia. β_1 represents the difference in mortality rates between reforming CON law states and non-reforming CON law states.

The presence of CON laws in of itself is not enough to tell us about the impact of such policies on health care access. If you live in a CON law state with few individuals utilizing hospital servicers, there should not be a strong impact of relaxing CON law on health care access. Within model (3) we incorporate hospital care utilization, as represented by hospital and ICU bed use, into the model to determine if there were difference in the mortality after reforming CON laws between states with high hospital utilization and low utilization.

$$y_{st} = \beta_0 + \beta_1(ReformCON_s) + (\boldsymbol{ReformCON_s * Post_t * Z_{st}})\delta + M'_{st}\psi + \alpha_s + \mu_t + \varepsilon_{st} \qquad (3)$$

We look at the average number of hospital and ICU beds available for COVID patients, given the total availability of such services. In the rest of the paper, we use the term hospital bed utilization or ICU bed utilization to refer these variables for the total hospital or ICU, respectively. Since supply of hospital beds and ICU units is relatively fixed, states that have high cases of COVID patients utilizing more beds and ICU facilities will struggle to get these resources to other patients suffering from other diseases.

Our data provides us the estimated number of hospital beds and ICU beds available, as well as the upper and lower limits of these services. Our hypothesis is that states with high health care utilization due to COVID will see more access problems in states with CON laws than those without. In turn, this would imply that they would see a large benefit resulting from an increase in purchasing power due to increased access. Within specification (3), we include these variables capturing health care utilization by COVID in vector Z and interact it with ***ReformCON*Post*** to determine how relaxing CON laws in states with high health care utilization by COVID patients affects mortality rates for COVID and non-COVID population.

Z is a continuous variable and higher values reflect more usage of hospital and ICU services by COVID patients. Vector **M** contains the double interactions between our group dummy variables and variables in vector **Z**, as well as the overall supply of hospital beds and ICU beds in each state. Therefore, **M** is a vector that includes interactions between dummy variables *CON* and *ReformCON*, and health care services utilization rates (hospital beds and ICU beds), along with availability of health care services in each state. The coefficient of interest is δ, which captures the effect of reforming CON laws by the suspending states on mortality relative to mortality rates in the non-reforming CON law states. When we include states that have never had CON laws into the control group, the results stay same.

V. Results

Our primary results are detailed in Tables 5 through Table 8. We only report the lower bound of our estimates in the paper to report the most conservative estimates[6]. Table 5 and Table 6 presents results of

[6] The upper bound estimates are available from authors upon request. We will be reporting these estimates in an online appendix.

empirical specifications (1) and (2). Both tables show a statistically insignificant result on the main coefficient of interest (***ReformCON*Post***). This implies that the average result of relaxing the CON laws do not have any impact on reducing mortality rates. This might be due to not controlling for utilization of hospital services and rates of COVID infection within a given state, which we do later with specification (3). However, we do find that mortality rates are higher in states with CON laws, relative to that in states without CON laws. Specifically, we see that there are approximately six more natural deaths per 100,000 people in states with CON laws relative to states without CON laws. This is consistent with theoretical implication that states with CON laws have more access problems to health care services, resulting in higher mortality rates than non-CON states.

The rate of death for respiratory and other diseases in our sample is higher in states with CON laws (reforming or otherwise) relative to those without. We find that reforming CON law states have a higher rate of COVID related mortality than non-reforming CON states, even though both types of states see higher COVID related deaths than states without any CON laws. We see similar results for deaths due to diabetes, Alzheimer's, influenza or pneumonia, or chronic lower respiratory diseases. Average deaths due to these underlying causes is higher in states with CON laws relative to that in states without such policies. Similar to our results with COVID and natural deaths, we see that the average effect of relaxing the CON laws is statistically equal to zero, suggesting no real effect on average.

We report our results of specification (2) in Table 6, using the non-reforming CON states as the control group. The fundamental results do not change from Table 5. None of the coefficients of interest are statistically significant. Deaths due to COVID is statistically lower in reforming CON law states than in the non-reforming CON law states. However, we do find that there are systematic differences between reforming versus non-reforming CON states for the other types of mortality, such as Alzheimer's, chronic lower respiratory diseases, influenza and pneumonia.

Tables 5 and 6 give the baseline difference-in-difference estimate without controlling for utilization of hospital services by patients during the pandemic. We use specification (3) to capture this and report the results in Tables 7 and 8. We use two proxies to capture the impact of COVID infections on utilization of health care services: per capital average use of hospital beds and ICU beds by COVID patients respectively. This proxy is scaled by 100,000 to make interpretation of the results more consistent. Table 7 presents results on the impact of reforming CON laws by CON states with high hospital bed utilization on mortality rates in each state. Table 8 incorporates utilization of ICU beds and reports the results of the triple difference in specification (3). It is important to note that we use non-reforming CON states as our control group in both the tables. Variable Z controls for the average estimate of hospital beds being utilized (or ICU beds utilized) per hospital bed (or ICU beds) available in that state in that week. The main coefficient of interest in specification (3) is δ, which captures the impact of suspending CON laws by a state that previously had a CON policy on mortality rates.

After controlling for proxies to capture utilization of hospital beds by COVID patients, we find that mortality is reduced in states that temporarily suspend their CON laws for COVID or similar causes of death that might use similar resources. The coefficient for ***ReformCON*Post*Z*** is negative and statistically significant for COVID, natural causes, diabetes, influenza and pneumonia, and chronic lower respiratory diseases. The magnitudes are much larger for COVID and natural causes of death relative to those for death due to the other causes. Our estimates in Table 7 suggest that the temporary suspension of CON laws by the reforming states with higher utilization of hospital beds by COVID patients led to twenty-one fewer deaths due to COVID and twenty-nine fewer deaths due to natural causes per 100,000 people. This might be because many states directed most of their resources towards COVID related health issues. States that relaxed their CON regulations saw a statistically significant decline in their mortality rates due to COVID. The effect on natural causes might be due to the high correlation between morbidity in high-risk people who get infected with COVID.

The coefficients for diabetes, influenza and pneumonia, and chronic lower respiratory diseases are also negative but of a much lower magnitude than that for COVID or natural causes of death. We wonder whether the impacts on these types of mortality are due to people with pre-existing conditions being more likely to die due to COVID. Diabetes and chronic lower respiratory diseases are long term health issues that would put patients in the high-risk pool. Complications due to influenza and pneumonia would require the usage of intensive care beds or ventilators, resources that are also used by COVID patients. Effects on mortality due to septicemia and Alzheimer's are statistically insignificant, which may be since these medical issues are less likely to compete for the same resources as COVID.

In Table 8, Z represents ICU bed utilization. We find that the coefficient of interest (***ReformCON*Post*Z***) is statistically significant for all seven causes of death. The magnitudes are much lower for COVID and natural cause of death than what we got when using hospital bed utilization as a proxy for utilization of health care services. Reforming CON states with high ICU bed utilization by COVID patients that temporarily relax their regulation see a reduction of eleven and fifteen deaths per 100,000 in COVID related mortality and death due to natural causes respectively.

VI. Conclusion

Our research sought to answer two fundamental questions regarding the recent COVID-19 pandemic. First, do states that have legal limitations to expanding and acquiring healthcare related goods and services see a disproportionate impact on non-COVID related deaths. This is crucial since, with the massive surge in new patients demanding healthcare services, this provided a limit to beds, respirators, ambulatory services, and CT/MRI imaging, which are resources that may be necessary for the care of both COVID and non-COVID patients. This also pertains to how scarce resources such as medical equipment is distributed during a pandemic, shifting the demand curve for medical services to the right. Secondly, we sought to understand the impact of states reforming their CON laws through temporary suspension or repeal had on mortality rates. Did these reforms save lives or was it a "too little, too late" situation?

We conclude that the reforms to CON laws, without controlling for utilization of health care services, are not associated with significant changes in mortality rates. This illustrates that the detrimental impact of CON laws might be visible only for states that were disproportionately impacted by the COVID pandemic. When we expand to a triple-differencing methodology to account for hospital or ICU bed utilization, we discover a much more intuitively interesting relationship. States with high healthcare utilization, proxied by above average hospital bed or ICU bed utilization respectively, that reformed their

CON laws during the COVID pandemic saw a significant reduction in weekly deaths for both COVID and non-COVID patients. This reduction was prominent for natural death, Septicemia, Diabetes, Chronic Lower Respiratory Disease, Influenza or Pneumonia, and Alzheimer's with a net effect of 28 lives saved per 100,000 people.

This research is subject to various limitations. First and foremost, we cannot address for the evolutionary behavior of COVID. This may not be the same disease in one or two years that it is today. Furthermore, medical research might realize the true nature of COVID in the future. These estimates were developed using data from the initial CDC collection and reporting window of mid-March to late-June. Second, this preliminary data is based on death certificate data, which may have inherent reporting lags. In this, we would like to stress that our estimates are a lower bound of the CON law impact, using our most conservative methodology. Additional upper bound estimates are available in the online appendix upon request.

References

Bailey, J., (2018). The Effect of Certificate of Need Laws on All-Cause Mortality. *Health Services Research*, 53(1): 49-62.

Bayne, E., Norris, C., and Timmons, E., (2020). A Primer on Emergency Occupational Licensing Reforms for Combating COVID-19. Mercatus Policy Brief, Mercatus Center at George Mason University, Arlington, VA, March 26, 2020.

Conover, C. J., and Sloan, F. A., (1998). Does Removing Certificate-of-Need Regulations Lead to a Surge in Health Care Spending?. *Journal of Health Politics: Policy and Law*, 23(3): 455-481.

Cutler, D. M., Huckman, R. S., and Kolstad, J. T. (2010). Input Constraints and the Efficiency of Entry: Lessons from Cardiac Surgery, *American Economic Journal: Economic Policy*, 2(1): 51-76.

DiSesa, V. J., O'Brien, S. M., Welke, K. F., Beland, S. M., Hanna, C. K., Vaughan-Sarrazin, M. S., and Peterson, E. D., (2006). Contemporary Impact of State Certificate-of-Need Regulations for Cardiac Surgery: An Analysis Using the Society of Thoracic Surgeon's National Cardiac Surgery Database. *Circulation*. 111(20): 2122-2129.

DeLia, D., Cantor, J. C., Tiedemann, A., and Huang, C. S., (2009). Effects of Regulation and Competition on Health Care Disparities: The Case of Cardiac Angiography in New Jersey. *Journal of Health Politics: Policy and Law*, 34(1): 63-91.

Ford, J. M., and Kaserman, D. L., (1993). Certificate-of-Need Regulation and Entry: Evidence from the Dialysis Industry. *Southern Economic Journal*, 59(4): 783-791.

Haeffele, S., Hobson, A., & Storr, V. H., (2020). Coming Back from COVID-19: Lessons in Entrepreneurship from Disaster Recovery Research. Mercatus Policy Brief, Mercatus Center at George Mason University, Arlington, VA, April 29, 2020.

Ho, V., (2006). Does Certificate of Need Affect Cardiac Outcomes and Costs?. *International Journal of Health Care Finance & Economics*, 6(4): 300–24.

Ho, V., M.-H. Ku-Goto, M. H., and Jollis, J. G., (2009). Certificate of Need (CON) for Cardiac Care: Controversy Over the Contributions of CON. *Health Services Research,* 44(2 Pt 1): 483–500.

Kearns, R. D., Skarote, M. B., Peterson, J., Stringer, L., Alson, R. L., Cairns, B. A., Hubble, M. W., Rich, P. B., Cairnes, C. B., Holmes, J. H., Runge, J., Siler, S. M., and Winslow, J. (2014). Deployable, Portable, and Temporary Hospitals; One State's Experiences Through the Years. *American Journal of Disaster Medicine*, 9(3): 195-210.

Mitchell, M. D., (2016). Do Certificate-of-Need Laws Limit Spending? Mercatus Policy Brief, Mercatus Center at George Mason University, Arlington, VA, September 29, 2016.

Mitchell, M. D., (2020). First, Do No Harm: Three Ways that Policymakers Can Make It Easier for Healthcare. Mercatus Policy Brief, Mercatus Center at George Mason University, Arlington, VA, March 26, 2020.

Mitchell, M. D., Amez Droz, E., and Parsons, A. K., (2020). Phasing Out Certificate-of-Need Laws: A Menu of Options. Mercatus Policy Brief, Mercatus Center at George Mason University, Arlington, VA, February 25, 2020.

Ni, H., Paul, J. A., and Bagchi, A., (2017). Effect of Certificate of Need Law on the Intensity of Competition: The Market for Emergency Care. *Socio-Economic Planning Sciences*, 60: 34-48.

Popescu, I., Vaughan-Sarrazin, M. S., and Rosenthal, G. E., (2006). Certificate of Need Regulations Do Not Restrict Access to Coronary Revascularization after Acute Myocardial Infarction. *JAMA*. 295(18): 2141–2147.

Rivers, P. A., Fottler, M. D., and Younis, M. Z., (2007). Does Certificate of Need Really Contain Hospital Costs in the United States?. *Health Education Journal*, 66(3): 229-244.

Robinson, J. L., Nash, D. B., Moxey, E., and O’Connor, J. P., (2001). Certificate of Need and the Quality of Cardiac Surgery. *American Journal of Medical Quality,* 16(5): 155–60.

Stratmann, T., & Russ, J. (2014). Do Certificate-of-Need Laws Increase Indigent Care? Mercatus Policy Brief, Mercatus Center at George Mason University, Arlington, VA, July 15, 2014.

Stratmann, T., and Baker, M. C., (2016). Are Certificate-of-Need Laws Barriers to Entry? How They Affect Access to MRI, CT, and PET Scans. Mercatus Working Paper, Mercatus Center at George Mason University, Arlington, VA, January 12, 2016.

Stratmann, T., and Wille, D., (2016). Certificate of Need Laws and Hospital Quality, Mercatus Working Paper, Mercatus Center at George Mason University, Arlington, VA, September 27, 2016.

Stratmann, T., and Koopman, C., (2018). Entry Regulation and Rural Health Care: Certificate-of-Need Laws, Ambulatory Surgical Centers, and Community Hospitals, Mercatus Working Paper, Mercatus Center at George Mason University, Arlington, VA, February 18, 2016.

Vaughan-Sarrazin, M. S., Hannan, E. L., Gormley, C. J., and Rosenthal, G. E., (2002). Mortality in Medicare Beneficiaries Following Coronary Artery Bypass Graft Surgery in States with and without Certificate of Need Regulation. *JAMA,* 288(15): 1859–66.

Table 1. Descriptive Information on Common Medical Interventions for Severe Cases Requiring Medical Intervention

Cause of Death	Description	Common Medical Interventions for Cases Requiring Medical Intervention
SARS-CoV-2, commonly referred to as COVID-19	A highly infectious respiratory disease. Moderate cases can fever, cough, trouble breathing, muscle pains, chills, headaches, and sore throat. In some cases, serious medical problems may occur requiring hospital intervention. Serious illness may include life-threatening pneumonia and organ failure.	Inpatient management of severe disease can include ICU admittance with supplemental oxygen therapy and close monitoring of clinical deterioration.
Septicemia, commonly referred to as Sepsis	Blood poisoning derived from bacteria. Sepsis are most associated with lung infections, urinary tract infections, skin infections, and infections of the intestines. Symptoms may include loss of interest in food, fever, high heart rate, nausea, vomiting, light sensitivity, extreme pain, or fatigue.	ICU admittance with IV fluids and supplemental oxygen. In extreme cases, breathing machines, kidney dialysis, or surgery.
Diabetes	Several diseases related with imbalances and underproduction of insulin or physical inability to manage insulin. Signs of diabetes can include hunger, fatigue, frequent urination, dry mouth, itchy skin, slow healing sores, pain or numbness in extremities, and blurred vision. Serious complications can include high fever, hallucinations, and diabetic coma.	In the case of diabetic coma interventions include supplemental oxygen or breathing machines, surgery, and blood glucose management.
Chronic Lower Respiratory Disease	A group of conditions that affect the lungs with reversible or irreversible obstructions. Including but not limited to chronic obstructive pulmonary disease, chronic bronchitis, emphysema, asthma, pulmonary hypertensions, and occupational lung diseases. Severe cases of CLDR may include airway obstruction and symptoms such as shortness of breath, wheezing, chest tightness, chronic mucus producing coughs, respiratory infections, lethargy, and swelling.	Cases requiring hospitalization include interventions such as inhaled and oral steroids, antibiotics, supplemental oxygen, oxygen therapy, pulmonary rehabilitation counseling, and surgery for lung volume reduction, transplant, or bullectomy.
Influenza or Pneumonia	Influenza is a highly contagious viral infection while Pneumonia is an infection and inflammation in the lungs that can derive from viral, bacterial, or fungal sources. Influenza can directly cause Pneumonia. Symptoms include dry cough, fever, chills, shortness of breath, chest pain when breathing or coughing, and rapid breathing.	Severe cases requiring ICU intervention may include antibiotic or antiviral medication, intravenous fluids, supplemental oxygen, and respiratory or breathing treatments.
Alzheimer Disease	Alzheimer's is a type of dementia that affects memory, thinking, processing, and behavior. Alzheimer's is a progressive disease and worsens over time. Symptoms in mild to moderate cases include memory loss, confusion, poor judgement, difficulty with language, repeating questions, mood and personality changes, difficulty carrying out multistep tasks, and problems recognizing family or friends. Symptoms of severe cases of Alzheimer's can additionally include inability to communicate, weight loss, seizures, skin infections, difficulty swallowing, loss of bowel and bladder control, and aspiration pneumonia.	There is no cure for Alzheimer Disease, though there are some interventions that can decrease symptoms. Severe Alzheimer's that results in ICU admittance and are at high risk of loss of life can include interventions such as medication, intravenous fluids, and respiratory treatment. Since most ICU cases are terminal, patient caregivers may be recommended to withhold or withdraw life-prolonging treatment.

Table 2. Descriptive Statistics of Hospital Fatalities for the Week Before the Policy Change and the Last Week of Full Data for All Diseases

Week 10							
Best Case Scenario: Deaths Per 100,000							
State Type	**COVID-19**	**Natural**	**Septicemia**	**Diabetes**	**Chronic Lower Respiratory Disease**	**Influenza and/or Pneumonia**	**Alzheimer Disease**
Removed CON Laws During COVID-19	0.0251	16.2455	0.1949	0.3891	0.9062	0.3492	0.7062
Always Had CON Laws	0.0003	18.4625	0.1694	0.5418	1.2618	0.4187	0.6814
Never Had CON Laws	0.0023	16.3195	0.1488	0.4965	1.0835	0.3878	0.7207
Worst Case Scenario: Deaths Per 100,000							
State Type	**COVID-19**	**Natural**	**Septicemia**	**Diabetes**	**Chronic Lower Respiratory Disease**	**Influenza and/or Pneumonia**	**Alzheimer Disease**
Removed CON Laws During COVID-19	0.0374	16.2455	0.4486	0.5930	1.1020	0.6575	0.9020
Always Had CON Laws	0.0029	18.4625	0.4803	0.7701	1.3787	0.6654	0.7925
Never Had CON Laws	0.0208	16.3195	0.3184	0.6513	1.1382	0.5793	0.8339

Week 22							
Best Case Scenario: Deaths Per 100,000							
State Type	**COVID-19**	**Natural**	**Septicemia**	**Diabetes**	**Chronic Lower Respiratory Disease**	**Influenza and/or Pneumonia**	**Alzheimer Disease**
Removed CON Laws During COVID-19	0.8131	10.9827	0.0823	0.2467	0.4389	0.1115	0.3787
Always Had CON Laws	0.3530	9.6941	0.0394	0.2118	0.4267	0.0877	0.3615
Never Had CON Laws	0.5512	10.7314	0.0818	0.2898	0.5580	0.0792	0.4128
Worst Case Scenario: Deaths Per 100,000							
State Type	**COVID-19**	**Natural**	**Septicemia**	**Diabetes**	**Chronic Lower Respiratory Disease**	**Influenza and/or Pneumonia**	**Alzheimer Disease**
Removed CON Laws During COVID-19	0.9282	10.9827	0.1565	0.4964	0.6525	0.2125	0.6979
Always Had CON Laws	0.5076	9.7257	0.2283	0.3360	0.7001	0.3984	0.5252
Never Had CON Laws	0.7413	10.7314	0.2749	0.3302	0.6945	0.2076	0.6087

Table 3. List of Initial Documents Initiating CON Law Changes

State	Date	Legal Document
Alabama	April 2nd, 2020	5th Supplemental State of Emergency
Alaska	March 11th, 2020	Administrative Order No. 315
Connecticut	March 14th, 2020	Executive Order No. 7B
Georgia	March 20th, 2020	Executive Order 3.20.20.2
Indiana	March 16th, 2020	Executive Order 20-04 and Executive Order 20-05
Iowa	March 17th, 2020	Proclamation of Disaster Emergency
Maine	April 6th, 2020	Executive Order No. 35
Massachusetts	March 24th, 2020	Order of the Commissioner of Public Health Regarding Determination of Need Approvals Related to COVID-19
Maryland	April 3rd, 2020	Sec. 10.24.01.20 Emergency Certificate of Need. (Already established, MHCC Executive Director alerted hospitals of Emergency CON on April 3rd)
Michigan	March 17th, 2020	Executive Order No. 2020-13
Nebraska	March 31st, 2020	Executive Order No. 20-12
New Jersey	March 13th, 2020	Executive Order No. 103; followed by the Temporary Operational Waivers during a State of Emergency from NJ Commissioner
New York	March 23rd, 2020	Executive Order 202.10
North Carolina	March 12th, 2020	Executive Order No. 116 (March 10th); followed by NC DHHS memo to hospitals (March 12th)
Oklahoma	April 8th, 2020	Executive Order No. 2020-13
Rhode Island	April 10th, 2020	Executive Order No. 20-21
South Carolina	March 19th, 2020	Executive Order No. 2020-11
Tennessee	March 19th, 2020	Executive Order No. 15
Vermont	March 25th, 2020	Executive Order No. 01-20; followed by GMCB Certificate of Need Bulletin 002
Virginia	March 12th, 2020	Executive Order Amended Number 51 (2020)
Washington	March 30th, 2020	Proclamation 20-36

Note: Each state differs in their explanation of the COVID-19 adjustments. For example, some completely repeal CON laws while other categorize it as an emergency approval process or expand the percentage a hospital can increase things such as beds to a point that it is non-binding. There is no common language between states in the treatment of CON laws. Most executive orders do not directly waive CON laws but instead allow health departments to implement established emergency protocols that include temporary easement of CON laws. To the best of our knowledge these dates and orders are the initial point of capacity expansions in response to COVID-19 by state. Many were rescinded or repealed after our sample period.

Table 4. Testing Correlation of Hospital Utilization and Reforming CON Laws

	Hospital Beds Available	ICU Beds Available
ReformCON*Post	0.0744 (0.0619)	0.0061 (0.0048)
Time Fixed Effects	Yes	Yes
State Fixed Effects	Yes	Yes
Observations	506	506
R^2	0.9546	0.9548

**** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$*

*Note: ReformCON*Post equals 1 for reforming the policy, 0 otherwise. The sample period is only restricted to pre-policy implementation.*

Table 5. Coefficient Estimates of the Effect of Reforming CON Laws in the Post Period

	Underlying Cause of Death						
	COVID-19 Death	**Natural Death**	**Septicemia**	**Diabetes**	**Chronic Lower Respiratory Disease**	**Influenza or Pneumonia**	**Alzheimer Disease**
CON	0.0596*** (0.0000)	5.7335*** (0.0000)	-0.0072*** (0.0000)	0.7961*** (0.000)	1.0745*** (0.000)	0.3065*** (0.0000)	0.5591*** (0.000)
Reform	0.7021*** (0.1668)	5.3501*** (0.3857)	0.2867*** (0.0070)	0.3227*** (0.0146)	0.7089*** (0.0295)	0.2904*** (0.0182)	0.8149*** (0.0218)
ReformCON*Post	**-0. 3479 (0. 5776)**	**-0. 5615 (0. 9387)**	**0.0090 (0.0179)**	**-0.0125 (0.0397)**	**0.0022 (0.0621)**	**0.0681* (0.0402)**	**0.0245 (0.0596)**
Time Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Standard Errors	Cluster(State)	Cluster(State)	Cluster(State)	Cluster(State)	Cluster(State)	Cluster(State)	Cluster(State)
Observations	1,162	1,162	1,162	1,162	1,162	1,162	1,162
R^2	0.4717	0.6012	0.6741	0.5675	0.6368	0.5902	0.5226

**** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$*

Note: This model follows a difference-in-difference framework with staggered implementation, which is why we do not separately denote a Post variable since there are multiple treatment periods. Discussion of the required assumptions are in the methodology section. An example of interpretation for Septicemia is that states with CON laws at the beginning of the period saw 0.0072 less deaths per 100,000 individuals. The states that chose to reform their CON laws saw 0.2867 more deaths across all periods. When we analyze just the post period in ReformCON*Post, we observe that states that reformed their CON laws saw an increase of 0.0090 deaths in the post period, though this result was insignificant.

Table 6. Coefficient Estimates of the Effect of Reforming CON Laws in the Post Period Without No CON Ever States

	Underlying Cause of Death						
	COVID-19 Death	**Natural Death**	**Septicemia**	**Diabetes**	**Chronic Lower Respiratory Disease**	**Influenza or Pneumonia**	**Alzheimer Disease**
Reform	-1.9116*** (0.1933)	6.9136*** (0.4134)	0.1884*** (0.0074)	0.2126*** (0.0155)	0.8251*** (0.0304)	0.1859*** (0.019)	0.7577*** (0.0217)
ReformCON*Post	**-0.7358 (0.6866)**	**-0.7352 (1.0869)**	**0.0135 (0.0173)**	**-0.0218 (0.0432)**	**0.0160 (0.0669)**	**0.0626 (0.0434)**	**0.0051 (0.0619)**
Time Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Standard Errors	Cluster(State)	Cluster(State)	Cluster(State)	Cluster(State)	Cluster(State)	Cluster(State)	Cluster(State)
Observations	828	828	828	828	828	828	828
R^2	0.4842	0.5859	0.6739	0.5830	0.6931	0.5896	0.5833

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$

Note: This model follows a difference-in-difference framework with staggered implementation, which is why we do not separately denote a Post variable since there are multiple treatment periods. Discussion of the required assumptions are in the methodology section. An example of interpretation for Septicemia is that states that chose to reform their CON laws saw 0.1884 more deaths per 100,000 individuals across all periods relative to the states which had CON laws but did not change. When we analyze just the post period in ReformCON*Post, we observe that states that reformed their CON laws saw an increase of 0.0135 deaths in the post period, though this result was insignificant.

Table 7. Coefficient Estimates of the Effect of Reforming CON Laws in the Post Period and Incorporating Total Hospital Beds Available

	Underlying Cause of Death						
	COVID-19 Death	**Natural Death**	**Septicemia**	**Diabetes**	**Chronic Lower Respiratory Disease**	**Influenza or Pneumonia**	**Alzheimer Disease**
ReformCON	-0.4313** (0.2039)	1.1127* (0.6369)	0.3167*** (0.0118)	-0.2614*** (0.0858)	-0.0459 (0.1140)	-0.0556 (0.0937)	0.3216** (0.1471)
ReformCON*Post	1.4776*** (0.3208)	1.9512** (0.9373)	0.0002 (0.0186)	0.1239 (0.1131)	0.0348 (0.1514)	0.1278 (0.1204)	0.0931 (0.1939)
Z	20.0100*** (3.351)	16.3719* (8.7591)	-0.2504* (0.1459)	0.1728 (0.306)	0.3564 (0.6168)	0.2427 (0.2142)	0.1394 (0.4318)
CON*Z	-3.3312 (2.8551)	-0.7069 (8.9866)	0.4176*** (0.1547)	0.1822 (0.2953)	-0.2927 (0.9633)	0.5748* (0.3059)	0.4189 (0.3822)
ReformCON*Z	7.5426** (3.2996)	18.0212** (8.6463)	0.3143** (0.1498)	0.4014 (0.316)	0.126 (0.6084)	0.3604* (0.2068)	0.6478 (0.4243)
ReformCON*Post*Z	**-21.5582*** (1.1618)**	**-29.1675*** (2.4678)**	**-0.1240*** (0.0408)**	**-0.6462*** (0.0794)**	**-0.5854*** (0.1042)**	**-0.3802*** (0.0774)**	**-0.7364** (0.3221)**
Time Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Standard Errors	Cluster(State)	Cluster(State)	Cluster(State)	Cluster(State)	Cluster(State)	Cluster(State)	Cluster(State)
Observations	376	376	376	376	376	376	376
R^2	0.8635	0.8189	0.7398	0.6420	0.6933	0.7216	0.6235

**** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$*

Note: Z reflects the average number of hospital beds available for usage by COVID divided by total number of beds available in a given state at a given time. This model follows a difference-in-difference framework with staggered implementation, which is why we do not separately denote a Post variable since there are multiple treatment periods. Discussion of the required assumptions are in the methodology section. An example of interpretation for Septicemia is that states that chose to reform their CON and had high hospital bed utilization had a -0.1240 reduction in deaths within the post period.

Table 8. Coefficient Estimates of the Effect of Reforming CON Laws in the Post Period and Incorporating Total ICU Bed Available

	Underlying Cause of Death						
	COVID-19 Death	**Natural Death**	**Septicemia**	**Diabetes**	**Chronic Lower Respiratory Disease**	**Influenza or Pneumonia**	**Alzheimer Disease**
ReformCON	0.0378 (0.8479)	1.6327 (1.9213)	0.3183*** (0.0271)	-0.3546*** (0.091)	0.4423* (0.2316)	0.3107*** (0.1123)	0.7623*** (0.1856)
SwitchedCON	2.0716*** (0.3644)	2.7637*** (0.8683)	0.0048 (0.0170)	0.1424 (0.1065)	0.0419 (0.1511)	0.1405 (0.1161)	0.1231 (0.1900)
Z	7.1216*** (0.8579)	5.4934* (3.3195)	-0.0940* (0.0491)	0.0572 (0.1110)	0.0826 (0.2155)	0.0764 (0.0724)	0.0418 (0.1546)
CON*Z	-1.9546** (0.9974)	-0.8274 (3.6863)	0.1371*** (0.0529)	0.0509 (0.1088)	-0.2495 (0.2851)	0.1618* (0.0935)	0.1244 (0.1469)
Reform*Z	6.3069*** (0.8275)	11.2616*** (3.2366)	0.1285** (0.0535)	0.2351** (0.1192)	0.1461 (0.2123)	0.2323*** (0.0806)	0.3544** (0.1550)
ReformCON*Post*Z	**-11.2172*** (0.4906)**	**-14.9941*** (0.9842)**	**-0.0618*** (0.0211)**	**-0.3221*** (0.0459)**	**-0.2809*** (0.0495)**	**-0.2296*** (0.0489)**	**-0.3996*** (0.1015)**
Time Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Standard Errors	Cluster(State)	Cluster(State)	Cluster(State)	Cluster(State)	Cluster(State)	Cluster(State)	Cluster(State)
Observations	376	376	376	376	376	376	376
R^2	0.8618	0.8156	0.7406	0.6424	0.6944	0.7199	0.6235

**** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$*

Note: Z reflects the average number of ICU beds available for usage by COVID divided by total number of beds available in a given state at a given time. This model follows a difference-in-difference framework with staggered implementation, which is why we do not separately denote a Post variable since there are multiple treatment periods. Discussion of the required assumptions are in the methodology section. An example of interpretation for Septicemia is that states that chose to reform their CON and had high ICU bed utilization had a -0.0618 reduction in deaths within the post period.