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THE HEALTH AND EMPLOYMENT EFFECTS OF EMPLOYER VACCINATION MANDATES

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ABSTRACT

Health care facilities considering mandating staff vaccination face a difficult tradeoff. While additional vaccination coverage will directly reduce disease transmission within the facility, the imposition of a mandate may also cause vaccine-hesitant staff to quit, which could harm patient care. To study this tradeoff, we leverage comprehensive administrative data covering virtually all US nursing homes, including payroll-based records on approximately 500 million daily nurse shifts and weekly data on COVID transmission and mortality at each facility. We use a difference-in-differences framework to estimate the impact of employer-imposed vaccine mandates at 581 nursing homes on disease spread, employment outcomes, and several patient care metrics. While mandates did slightly increase staff turnover, the effects were concentrated on staff working less than 20 hours per week, and resulted in a reduction of less than two minutes per patient-day. Furthermore, there is only limited evidence of lower levels of care at mandate facilities in typically-monitored conditions such as patient falls, pressure ulcers, or urinary tract infections. In contrast, implementing a vaccine mandate led to large increases in staff vaccinations at mandate facilities, which directly led to less transmission of and lower patient mortality from COVID. We estimate that vaccine mandates saved one patient life for every two facilities that enacted a mandate, a large effect given the typical facility has around 100 beds. Our results suggest that the health benefits of mandates far outweigh the costs in terms of reduced patient care from staff turnover.

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1 Introduction

Shortages and rapid turnover of staff are among the deepest problems facing managers of health care facilities. According to recent forecasts, hundreds of thousands of additional physicians (Markit, 2021), nurses (Buerhaus, 2021) and lower wage staff such as Certified Nursing Assistants (CNAs) and home health aides (Creapeau, Johs-Artisensi and Lauver, 2022) will be needed just in the United States to keep up with demand for care. This shortage is especially acute for lower wage workers, where demand is predicted to rise by over 10% to 10.7 million workers by 2026, yet over 3 million net workers are predicted to leave the labor force (Bateman et al., 2021). Competition for the limited supply of staff combined with staff exit from the industry due to low wages, burnout, job difficulty and other factors have led to staff shortages and extremely high turnover in recent years. This is especially true in the nursing home industry, where facilities are often under-staffed (Geng, Stevenson and Grabowski, 2019) to the point that regulators are imposing staffing minimums (Lin, 2014), increasing minimum wages (Ruffini, 2022; Gandhi and Ruffini, 2022; Legislature, 2023), or offering facilities bonus payments (Gandhi et al., 2024) in attempts to improve staffing. Once staff are hired, retaining them is difficult; typical annual turnover was around 100% prior to the pandemic (Gandhi, Yu and Grabowski, 2021) and has only gotten worse, increasing by 25% between 2021 and 2022 (American Health Care Association, 2023*b*). Nursing home staff turnover is now double that of hospitals (Bergman, 2023), where staff shortages and the use of travel nurses have drawn attention (Hawryluk and Bichell, 2020; Gottlieb and Zenilman, 2024). A recent survey identified staff turnover as the single largest issue facing senior administrators of long-term care facilities (Bryant, 2017).

The COVID-19 pandemic caused many healthcare staff to burn out due to increased patient load and job stress, fear of infection, and other factors (Rizzo et al., 2023). This proved highly problematic for the nursing home industry, where both levels (Gorges and Konetzka, 2020) and consistency (Loomer et al., 2022) of staffing play a critical role in infection control and preventing outbreaks among highly vulnerable nursing home resident populations. Due to close proximity of patients and staff, health care facilities became focal points of infection that devastated patients and staff alike (Shen et al., 2022). Nowhere was this more true than nursing homes: in the first year of the pandemic, over 1,300 nursing homes had infection rates among patients of over 75%, and mortality rates of the old and infirm patients at these high-infection facilities averaged over 20% (Office of Inspector General, 2023). To make matters worse, COVID-19 outbreaks within nursing homes were found to spur staff departures (Shen et al., 2022), potentially creating a vicious cycle where decreased staffing after an outbreak would place facilities at increased risk for a another outbreak.

Vaccines held the promise to help break this vicious cycle (Polack et al., 2020; McGarry et al., 2022*b*), yet facility managers faced a difficult problem: vaccination rates among staff lagged that of patients and

other vaccine-eligible population members (McGarry et al., 2021*b*). Vaccine hesitancy—both in general and specifically for COVID—is strongest among non-white and low-income individuals, the dominant demographic for low-wage health staff that make up the majority of health care personnel (Liu and Li, 2021). Increasing vaccine coverage was strikingly difficult, with one randomized control trial involving 133 facilities and nearly 18,000 staff finding no statistically significant effect of soft-touch approaches—such as educational materials, town hall meetings, and messaging from community leaders—to improve vaccinations among staff (Berry et al., 2022).

Despite evidence that vaccine mandates are effective at increasing vaccination coverage (Abrevaya and Mulligan, 2011; Lawler, 2017; Carpenter and Lawler, 2019), facility administrators were reluctant to implement the hard-line approach of mandates, reporting fears that mandates could worsen already high turnover or even result in staff shortages (Gardner, 2022). Facilities risked losing large numbers of vaccine hesitant staff, which could even snowball into losing vaccinated staff if departures of non-complying staff increased workload and stress for others. Unlike government-imposed mandates, employer-imposed mandates are crucial human resources decisions that each firm makes separately. Managers' active choice to impose a mandate may strain the employer-employee relationship more than an externally imposed mandate. Moreover, the lack of coordination means that administrators may fear that vaccine hesitant staff can easily find a job at a nearby facility without a mandate. Ultimately, most facilities chose not to impose mandates, and interviews of facility administrators suggest that these concerns were crucial (Gadbois et al., 2023): administrators often cited "fear that staff would leave for facilities where vaccination was not required," and many "were in favor of a federal mandate, which made the government the 'bad guy' instead of them."

This variation between facilities that did and did not implement their own mandates provides a compelling quasi-experiment on the health and employment effects of employer-imposed vaccination mandates. Studying this tradeoff helps us to answer one of the most important managerial questions facing administrators at health facilities: in the face of workforce challenges such as staff shortages, high turnover, and a very tight labor market, is it worthwhile for managers to impose a practice that enhances patient and worker safety but is disliked by some staff? Imposition of a mandate is likely to reduce COVID transmission at the facility. Indeed, prior research has documented that state laws that require influenza vaccination among hospital employees were associated with reductions in influenza and pneumonia mortality (Carrera, Lawler and White, 2021). However, because staffing levels are so critical to patient health and quality of care (Lin, 2014; Friedrich and Hackmann, 2021), if the mandate causes enough workers to leave, it could endanger the very patients it aims to protect.

In this study, we combine several comprehensive databases and employ a quasi-experimental event study design to estimate the effect of a facility-level vaccine mandate at nursing homes. We estimate effects on

measures of staff turnover, patient care, and patient health (including but not limited to patient mortality). We use detailed payroll-based data on nearly 500 million daily nursing staff shifts by over 5 million staff members at nursing homes; comprehensive data on the announcement and introduction of employer-level vaccine mandates at nursing home chains; facility-level data from the Centers for Disease Control and Prevention on vaccination coverage, COVID infections, and COVID-related deaths among residents and staff; and a wide variety of patient outcomes associated with the level of care (e.g., injuries from falls, pressure ulcers, etc). We also use data on concentration of nursing homes within a geographic area and patient demographics at facilities to examine the effects of labor market concentration and equity, respectively. To our knowledge, this is the first comprehensive, quasi-experimental study of the effects of employer-imposed vaccine mandates on health, worker turnover, and the efficacy of a vaccine mandate in a labor market with chronic shortages.

We find large, positive effects of employer-level mandates on vaccine uptake by staff. This had life-saving spillovers on the health of nursing home residents, who saw a reduction in both COVID cases and mortality. For every two facilities that issued a mandate, approximately one life was saved. Given that the typical facility has only 100 residents, this is a large effect. While we do find a statistically significant increase in turnover and decrease in staff time spent on patient care at mandate-issuing facilities, the magnitude of these effects is small. For example, the mandates reduced patient care by about two minutes per patient-day, which is just 1.89% of the mean. Also, the additional separations are concentrated among part-time staff working less than 20 hours a week at a facility. Turnover among such staff is already common and is likely to be less disruptive than separations of full-time staff (Kesavan, Staats and Gilland, 2014; Clemens et al., 2021). Quite tellingly, we find very limited evidence of reductions in care when examining conditions typically considered to indicate poor quality care such as injuries from falls, urinary tract infections, and pressure ulcers. Interestingly, we find that the concentration of nursing homes in a geography is not correlated with mandate-induced turnover, suggesting geographic labor market competition is not a major mediator in whether or not vaccine hesitant staff choose to comply. Finally, and worryingly, we find that existing inequalities in health care may be exacerbated by employer-level mandates: facilities in richer locations with a higher concentration of white residents are more likely to issue mandates, and as a result, lower income patients and patients of color are less likely to benefit from the mortality reductions caused by the mandates.

This paper makes several important contributions. To our knowledge, it is the first comprehensive, quasi-experimental study that investigates the tradeoffs between patient health and employee turnover when an employer issues a vaccine mandate. However, it also speaks to the broader theoretical and managerial questions around optimal management of health care facilities in the face of staff turnover. Human resource management at its core involves consideration of the tradeoffs between employer requirements and the

preferences of personnel (Larkin, Pierce and Gino, 2012), and many HR policies in health, such as shift allocation, workday length, job assignment and many others contain the same tradeoffs between efficiently and effectively taking care of patients and ensuring critical personnel achieve sufficient job satisfaction (Platis, Reklitis and Zimeras, 2015). Finally, our study contributes to the ongoing debate on disparities in health care, and how the delegation of policies such as mandates to the private sector—as opposed to mandates and other regulations decided at the government level—may exacerbate existing inequalities in health.

The paper is organized as follows. Section 2 briefly overviews the theoretical logic and existing literature on the tradeoffs of HR policies such as mandates on patient care and employee turnover in health settings. Section 3 describes the nursing home industry and gives details around vaccine mandates. Section 4 outlines the data used in the study, and Section 5 lays out the empirical strategy and results, including robustness checks. Section 6 discusses the results and gives theoretical and managerial implications, study limitations and ideas for future work.

2 Theoretical Background and Related Literature

Ensuring high-quality patient care is paramount to the mission of health care organizations. Frontline workers, who directly interact with patients, are the most important factor affecting care. Therefore, attracting, retaining, and motivating these staff is critical providing high-quality care (Borkowski and Meese, 2020). High rates of employee turnover have been causally linked to worse performance across a variety of industries and contexts (Li et al., 2022). Turnover among direct-care healthcare workers can be particularly damaging and has been linked to variation in process standards that result in poor care and adverse outcomes (Tucker, Nembhard and Edmondson, 2007; Antill et al., 2025; Moscelli et al., 2023). Turnover can also decrease quality of care through increasing variation in team composition (Bartel et al., 2014) and even creating staffing shortages (Friedrich and Hackmann, 2021).

A vaccination mandate could exacerbate turnover if vaccine-hesitant employees choose to depart the organization rather than comply with the mandate. One October 2021 survey of more than one thousand employers found that 75% were concerned about employee turnover in response to a vaccination mandate Mercer (2021). The "job demands-resources model" (JD-R) framework, a prominent theory used to study employee turnover in health and many other settings, posits that both a job's demands and the resources provided determine employee well-being, burnout, and ultimately turnover (Demerouti et al., 2001). Other studies have shown the JD-R framework to be predictive of turnover in a variety of contexts (Bakker and Demerouti, 2007; Fernet, Austin and Vallerand, 2012; Carlson et al., 2017), including for nursing staff specifically (Broetje, Jenny and Bauer, 2020). The framework has also been shown to predict burnout, negative well-being, and quitting of health care workers in response to the COVID-19 pandemic (Zhou et al.,

2022).

Requiring an unvaccinated employee to vaccinate represents a substantial demand on that employee, as it requires them to receive a medical treatment that they would not have voluntarily chosen to receive. Indeed, Troiano and Nardi (2021) shows that hesitant individuals' reservations are quite significant and that hesitancy is strongest among demographics typical of nursing home staff: young people, women, ethnic minorities, and individuals with lower education levels, and those of lower socioeconomic status. Employees may regard mandates negatively regardless of vaccination status if mandates are perceived as overbearing, unethical (Gur-Arie, Jamrozik and Kingori, 2021), or unjust (Mengstie, 2020).

The JD-R framework therefore predicts that the substantial demands of vaccination mandates will either result in greater turnover or else require the employer to expend significant resources to compensate for the demands stemming from the mandate, and thereby retain their employees. Assuming the mandate causes some turnover, the net effect of a vaccine mandate on patient health depends on which effect dominates: the reduction in COVID transmission from increased vaccination coverage (Nordström, Ballin and Nordström, 2021; McGarry et al., 2022*b*), or the reduction in patient care caused by the increased turnover. The net effect of a vaccine mandate on patient care is not obvious ex-ante. Freedman et al. (2023) show that the protective effect of vaccines for others—i.e. the "indirect" or "spillover" effects—can vary substantially and need to be estimated specifically for each context. Likewise, the employment effects of mandates may vary by context.

There is a substantial literature on the negative effects of turnover on patient care and customers outside of health care settings. The first part of the literature focuses on the tradeoff between efficiency and care, which is greatly exacerbated by turnover. Care demands in health care are highly stochastic (Kc and Terwiesch, 2009), and adjusting workers' shifts to match this volatility leads to significant turnover (Bergman, David and Song, 2023). Healthcare managers must therefore inherently weigh staff utilization and staff responsiveness (Berry Jaeker and Tucker, 2017). Systems which are optimized towards high utilization can reduce staff responsiveness, leading to a higher number of accidents and fatalities in hospitals and other health care settings (Kuntz, Mennicken and Scholtes, 2015). These systems can also distort care decisions during times of peak demand, leading to suboptimal care (Freeman, Savva and Scholtes, 2017).

Managerial methods to increase flexibility while not harming efficiency can have unintended consequences. For example, one commonly-used method to increase flexibility is the greater use of part-time or contract staff instead of full-time or permanent staff; however, both approaches have been shown to cause declines in patient care (Bourbonniere et al., 2006; Konetzka, Stearns and Park, 2008; Lu and Lu, 2017). Higher turnover makes the management of this tradeoff even more difficult because it reduces both utilization—since new employees are not immediately as productive as those they replaced—and responsiveness because high turnover is associated with greater instances of low staffing levels and reduced performance in times of high

or unexpected demand (Ton and Huckman, 2008).

A second mechanism by which turnover harms patient care is behavioral. Staff morale is harmed by high turnover, which can ultimately harm patients through lower quality care, and from inducing even higher rates of turnover as burned out employees leave their job. High turnover and the resulting inflexibility in staffing can also increase stress on employees that remain at an organization (Staw, 1980). For one, workloads on remaining employees can increase, leading to feelings of overwork and burnout (Avey, Luthans and Jensen, 2009). With high turnover, remaining staff are also asked to more frequently work on tasks on which they do not feel as competent or do not like, which reduces job satisfaction (Adler, Skov and Salvemini, 1985; Huckman and Staats, 2011). Finally, workers feel stress and perform less well when colleagues leave the company, particularly when the departure is involuntary or due to a dispute with the employer (Choudhury et al., 2024). Workers who feel stressed are more likely to make mistake (Hunter and Thatcher, 2007). Additionally, stressed workers are themselves more likely to subsequently quit, leading to a snowball effect. The COVID-19 pandemic only exacerbated the stress caused by employee turnover in health care settings; not only did turnover spike during outbreaks at healthcare facilities (Shen et al., 2022), but the pandemic also led to large shocks in patient demand, significant uncertainty, and a huge amount of stress on nurses and other frontline staff (Tolksdorf, Tischler and Heinrichs, 2022).

Management decisions around these tradeoffs causally affect the performance of health care organizations, including around patient care (La Forgia, 2023; Lu and Lu, 2022). Specifically, managers in health care organizations must reduce turnover from sub-optimally high levels and promote desired levels of service (Tan and Netessine, 2014; Dai and Tayur, 2020). Managing this tradeoff is not easy because increasing employee satisfaction reduces both turnover and error rates, but also reduces efficiency (Grant, Christianson and Price, 2007).

The efficiency-care tradeoff has been studied in several previous papers. One prominent example of this effect is found in the overtime laws enacted to protect nurses in many jurisdictions from overly long working hours. These reduced demands led to a higher degree of job satisfaction and less burnout, but also led to reductions in patient care, both in terms of time spent with patients, and in the quality of care given since care was more likely to be provided by part-time or inexperienced staff (Lu and Lu, 2017). Another example is “endogenous absenteeism,” where nurses and other health care staff react to the announced schedule to call in sick in times where they anticipate being overworked (Green, Savin and Savva, 2013). Managers face the choice of overscheduling nurses and reducing efficiency, or rationally scheduling and increasing absenteeism, stress on remaining workers, and the incidence of poor quality of care. A third example comes in the turnover effects of "efficient" scheduling, which allows employers to more flexibly react to unforeseen demand. This flexibility can increase care to patients during periods of unexpected demand, but employees often react to

the "efficient" practice of increasing schedule volatility by quitting, which reduces patient care (Bergman, David and Song, 2023).

Another related literature is on other factors beyond the focal job's demands and resources that contribute to a decision to leave a job. Like employees in any other industry, employees in health care will consider their job market prospects when deciding whether to leave their current job. A long literature has shown that one of the strongest predictors of turnover is a worker's employment options at other firms (Lee et al., 2008). Turnover is more likely when workers can easily find another job, and this is particularly true when there are many available jobs at the local level, since workers are less likely to depart a job if it requires them to find a new residence in a new geography (Jäger et al., 2024).

The most closely-related prior study is McGarry et al. (2022*a*), which finds that state-imposed vaccination mandates for healthcare workers increased vaccination coverage without resulting in self-reported staffing shortages. Our study differs conceptually from McGarry et al. (2022*a*) in examining the tradeoffs that managers face in proactively implementing a mandate, rather than estimating the empirical effects of an externally-imposed one. Employer-imposed mandates are also plausibly both less effective and result in greater staff turnover than government-imposed ones. Awareness that an employer actively chose to impose a mandate could strain the employer-employee relationship more than an externally-imposed mandate. Moreover, when an employer unilaterally imposes a mandate, staff may leave to work for competitors that did not do so. Finally, our empirics also differ from McGarry et al. (2022*a*) in the extent of our outcomes analysis, as we are able to leverage rich administrative data to measure real staffing responses, COVID-related health outcomes for both patients and staff, and non-COVID care outcomes for patients.

3 Institutional Environment

The nursing home industry plays a significant role in the care of a large portion of the population in the United States. There are over 15,000 nursing homes certified by the Centers for Medicare & Medicaid Services (CMS) that serve over 1.2 million patients (Kaiser Family Foundation, 2023), and over 10,000 long-term care facilities not certified by CMS that serve many more older Americans. Close to 5% of Americans aged above 65 live in a nursing home. The size of nursing homes varies, with an average facility having approximately 100 beds. Nearly 70% of nursing home facilities are operated by for-profit companies, with the remainder primarily being nonprofit and a small minority being government-owned.

At any given time, approximately 1.5 million workers are employed at a nursing home, but frequent turnover means that over 3 million individual workers have been employed by a nursing home in the last two years (American Health Care Association, 2023*a*). Over half (53%) of nursing home employees are certified nursing assistants (CNAs); other patient-facing staff include physical, occupational, and speech therapists,

licensed practical nurses (LPNs), and registered nurses (RNs). CMS emphasizes the importance of RNs for quality of care in the five-star rating system (Centers for Medicare & Medicaid Services, 2019), but only require that facilities employ eight hours of RN care each day and have at least one RN or LPN on duty at all times. Many but not all states have stricter regulations on staffing levels (Harrington, 2010; Lin, 2014). These are often specified as a minimum number of hours of direct care per patient day overall or by staff type; however, many states require only that there be "sufficient staff to meet resident needs" (Consumer Voice, 2021). While technology can substitute for some staff tasks (Lu, Rui and Seidmann, 2018), the majority of direct patient care must be provided by nursing staff.

The COVID pandemic hit nursing home patients and employees particularly hard. In the early wave of the pandemic, an estimated 42% of COVID deaths nationwide occurred in nursing homes (Abrams et al., 2020). This is unsurprising; as one analysis described, nursing homes represent a "perfect storm" of attributes that would predict COVID spread and mortality (Ouslander and Grabowski, 2020). Residents live in close proximity with each other, often sharing communal spaces, bedrooms and bathrooms, which allows disease to spread between residents. More importantly, nursing home residents require regular assistance with activities of daily living—such as bathing, toileting, and moving—meaning that staff must be in close proximity to assist and provide care to residents. Staff cover many patients within a facility and may even work at multiple facilities (Chen, Chevalier and Long, 2021), allowing a single staff member to potentially infect a large number of patients.

Nursing home patients are highly vulnerable to COVID given that the average resident is over 80 years old and has multiple health comorbidities. By the end of 2020, almost 20% of the nearly 600,000 COVID cases at nursing homes resulted in death (Shen et al., 2021). Although nursing homes took steps to limit exposure, like eliminating family visits and implementing surveillance testing (McGarry, Gandhi and Barnett, 2023), these methods could not entirely prevent deadly outbreaks (Dykgraaf et al., 2021). Even nursing homes taking significant precautions could not prevent all opportunities for COVID to enter the facility. First, newly admitted patients could already be infected (McGarry et al., 2024). Even more importantly, because nursing home staff do not live in facilities they can become infected outside of work and seed outbreaks at the facility (McGarry et al., 2021*a*; Shen, 2022).

As vaccines against COVID were released in December, 2020, health care workers, first responders, and nursing home residents and staff were among the first groups to receive the vaccines. Despite uneven supply and some logistical difficulties in distributing vaccines to the large number of facilities and patients, over 80% of nursing home patients were fully vaccinated within six months of vaccine release (McGarry et al., 2021*b*). In contrast, vaccination rates of employees lagged significantly, with overall vaccination rates of only 60%. Physician and therapist vaccination rates approached that of patients, but less than 50% of CNAs—who

interact most closely with patients and constitute the majority of nursing home staff—were vaccinated by July, 2021 (McGarry et al., 2021*b*). Within all roles, employees with shorter tenures and those who were non-white were less likely to vaccinated (McGarry et al., 2021*b*).

Low rates of staff vaccination became a national concern as outbreaks continued to disproportionately devastate facilities with many unvaccinated staff (McGarry et al., 2022*b*). Various mandates were proposed at the state and federal level. These were ultimately highly effective (McGarry et al., 2022*a*; Razzaghi et al., 2022), but passage and enforcement were slow and often met with political and legal challenges. For example, the federal mandate for healthcare worker vaccinations only overcame legal challenges on January 13, 2022 and enforcement only started on February 28, 2022.

In the long period before government mandates, nursing homes were left to address poor staff vaccination themselves. Many facility managers took steps to promote vaccines, including providing educational material, holding town hall meetings with staff, providing gifts such as T-shirts or coffee mugs to vaccinated employees, and undertaking messaging campaigns from community leaders with shared heritage of many staff. A careful randomized control trial (RCT) of six such strategies at skilled nursing facilities across nearly 20,000 staff found these campaigns had no discernible effect on vaccination rates (Berry et al., 2022).

In this context, some nursing homes and chains implemented their own vaccination mandates. These were highly controversial, as their efficacy was uncertain and many worried that that vaccine hesitant staff would quit to work for competitors without mandates (Gadbois et al., 2023). In the following sections, we estimate the effect of these mandates on both the health outcomes of residents as well as on facilities' staffing.

4 Data

In this section, we describe the data used in our analysis. Section 4.1 details our study period, and Section 4.2 describes the set of employer-imposed mandates that we examine. Sections 4.3 and 4.4 describe the data we use to construct outcome measures, and additional details are provided in Appendix A.2.

4.1 Study period

This study focuses on the employment and health outcomes of nursing home employees and patients at facilities that announced a vaccine mandate for staff prior to September 9, 2021, when the Biden Administration publicly announced the intent to impose multiple national COVID-19 vaccination mandates, including one covering virtually all healthcare workers (CMS, 2021*b*).[1] We focus on these mandates as they are the most likely to be perceived by workers as a substantial imposition by their employer rather than an advance

[1]Note that the Biden Administration articulated an intent to mandate vaccinations for nursing home staff specifically on August 18, 2021 (CMS, 2021*c*). However, the September 9, 2021 announcement was likely more salient to the public, as it was more heavily advertised and articulated a plan to require vaccination of virtually all healthcare workers and federal workers. Our results are robust considering only employer-imposed mandates that were announced before August 18, 2021.

implementation of a federal directive. This approach is quite conservative, as it wasn't until November 4, 2021 that CMS published a regulation mandating vaccination for healthcare workers (CMS, 2021*a*). The initial deadline stated in this regulation was January 4, 2022, however litigation and then various delays and exceptions across states led enforcement to occur considerably later in many states.

The first employer-imposed mandate in our sample was announced on December 28, 2020, less than a month after the first COVID vaccines received Emergency Use Authorization. The last employer-imposed mandate in our sample was announced on August 31, 2021. To the extent possible, we track all outcomes for 13 weeks prior to mandate announcement and for up to 26 weeks after announcement. We exclude all outcomes after Jan 2, 2022, to ensure that we do not include any weeks that occur after the Federal mandate was initially scheduled to take effect. Therefore, our study period includes the weeks from September 21, 2020 until Jan 2, 2022, with variation across outcomes depending on data availability.[2] Additionally, since some states implemented vaccination mandates prior to the federal government, we exclude any facility-weeks during which a state-imposed mandate would have applied.

4.2 Employer-imposed mandates

We collected data on nursing home vaccine mandate announcement date and effective date from McKnights, a leading online publication for senior living (see Appendix A.1). The frequent outbreaks of COVID at nursing homes was a prominent issue in the senior living community, so McKnights staff regularly surveyed nursing home chains—organizations that own more than one nursing home—on their mandate plans, and listed new mandates on a weekly basis. Eighteen chains introduced mandates during the study dates.[3] Five of these chains were excluded due to poor quality payroll data. The thirteen remaining mandate chains consist of 581 nursing homes that announced and implemented mandates during the study period, representing the treatment group. The 9,242 nursing homes that did not report a mandate to McKnights are the control group. Figure A1 shows the geographic distribution of facilities with mandates announced during the study period (hereafter "treatment facilities" or "treatment group"), and that of facilities with no mandate (hereafter "control facilities" or "control group").

While we believe McKnights was diligent in identifying and reporting mandates given the prominence of this issue at the time, we cannot definitively rule out that some facilities implemented mandates that were not reported. If so, these facilities would be incorrectly included in our control group and failing to account for their treatment would most plausibly bias our estimates against finding an effect of mandates.

[2]The study period includes 2019q3 through 2023q1 for outcomes related to adverse patient events in Figure 6. Data in Nursing Home Compare, which was used to calculate these measures, were reported at the quarter level, and the longer study period allows us to measure outcomes for six quarters post mandate enforcement.

[3]Note that many of the mandates we study had religious, medical or other exemptions, since legal observers believed they were required under state or federal law.

4.3 Nursing home employment and shift data

CMS maintains a Payroll-Based Journal (PBJ) for nursing homes which records all individual staff shifts for all CMS-certified nursing homes at the employee-day level. To ensure adequate within-facility power, we only include facilities with 40 or more beds, but this excludes only a very small number of facilities. During the study period, there were 489 million individual shifts by 5.1 million individual staff members. Because the employee identifier is facility-specific, a staff member who worked at more than one facility in the sample period shows up as a separate employee in the data. The 5.1 million staff member figure is therefore an overcount, as some staff worked at more than one facility.

The data report total hours worked by a given worker on a given day, the worker's role (e.g., CNA, LPN, RN, etc), and whether the worker was paid an hourly wage, a fixed salary, or via a contract arrangement (for example via an agreement with an employment agency specializing in nursing home staff). We focus our main analysis on CNAs, since they are the most common employee type, and also were by far the least vaccinated group of employees before mandates were issued.

Because we observe a worker's shifts over time within the same facility, we can identify whether a worker is a new hire at a given facility, the date they last worked at a facility, and whether a worker is full-time (35+ hours per week at a given facility), part-time (20-34 hours), or very part-time ($<$ 20 hours). Unfortunately, we do not observe demographic or other information about staff. For analyses using the PBJ data, some control group chains were dropped from the study sample due to PBJ data quality issues; Appendix A.3 describes these exclusions.

CMS also reports basic data on all certified facilities including location, ownership, bed size, and other similar data via the publicly-available Provider Information File.

4.4 Patient health data

We used data from the Center for Disease Control's National Healthcare Safety Network (NHSN) to observe COVID-19-related patient health outcomes at nursing homes. These data, which the CMS required all certified nursing homes to report at the weekly level throughout most of the pandemic, include COVID vaccination, infection and mortality rates for both patients and staff. We do not use mortality rates among staff in our analysis because employee death is very rare in the data. When assessing COVID transmission and mortality, we extend the study period to January 2, 2022. This reflects the lag between vaccination and potential immunity from vaccination.

To study non-COVID dimensions of quality, we use quarterly quality measures from CMS' Nursing Home Compare tool. These measures are based on residents' health assessments and have been shown to strongly

represent the quality of patient care provided by a facility (Harrington et al., 2000; Hickey et al., 2005; Omotowa and Hussey, 2020). These negative health outcomes include bladder incontinence (many patients require assistance to use the restroom, and suffer incontinence if staff are slow to help), urinary tract infections, the use of physical restraints on patients, an injury that is the result of a fall (which often occurs when staff fail to provide adequate supervision or support to residents with mobility impairments), the inappropriate use of anti-psychotic medications (a form of chemical restraint), or the presence of pressure ulcers (which can occur if staff do not properly reposition the bodies of mobility-impaired patients, and can be exacerbated by incontinence). We focused specifically on these measures as they are all markers of adequate staffing levels and would be expected to be sensitive to staff shortages resulting from mandate-induced departures.

5 Empirical Analysis

In this section, we use an event study difference-in-differences methodology to estimate the effect of an employer vaccine mandate on employment and health outcomes. This approach extends the two-period difference-in-differences model to assess the dynamic evolution of mandate effects by estimating treatment effects for each period within an event window. To avoid potential negative-weighting from comparisons between facilities that implemented mandates at different times (Goodman-Bacon, 2021), we employ a "stacked" event study design (Cengiz et al., 2019) that only compares "treated" facilities that implemented a mandate to "control" facilities that never imposed a mandate within our study period. Stacking accomplishes this by constructing separate cohorts for each week on which treatment occurs—i.e., on which a mandate is announced or enforced (Table A1). Each cohort includes only facilities that became treated on that index week and a set of control facilities that are never treated during the study period. We follow each cohort over the event window around the mandate and allow for the cohort and time fixed effects to be cohort-specific in order to ensure that event study estimates are identified from within-cohort comparisons.[4]

Formally, our regression equation is:

$$y_{c,i,t} = \eta_{t-\tau(i)} M_i + \gamma_{c,i} + \theta_{c,t} + \epsilon_{c,i,t} \tag{1}$$

where $y_{c,i,t}$ represents the outcome of interest for the observation corresponding to nursing home i in cohort c in calendar week t. The terms $\gamma_{c,i}$ and $\theta_{c,t}$ are cohort-specific facility and calendar-week fixed effects, respectively. M_i is an indicator for whether nursing home i is subject to a vaccine mandate, and $\tau(i)$ represents the announcement or enforcement date of the vaccination mandate so that $t - \tau(i)$ is event time

[4]For most analyses, we use an event window that spans from 13 weeks prior until 13 weeks after the mandate announcement (or enforcement). For epidemiological outcomes (i.e., Covid-19 cases and deaths), we use a window that is 10 weeks prior until 26 weeks as the protective effects of vaccination may take longer to manifest.

relative to mandate announcement or enforcement. The coefficient η_k is therefore the effect of the mandate announcement (or enforcement) on the outcome variable for event week k relative to an excluded reference period. We cluster standard errors at the chain level since the mandates were typically determined at the chain level (Abadie et al., 2023).

For models that examine mandate announcement, our reference period is the week before the announcement. In other words, each η_k represents the estimated difference between treated and control units in event-period k relative to the difference in $k = -1$. For models that examine mandate enforcement, we chose four weeks before enforcement ($k = -4$) as the reference point. This is intended to capture the fact that recommended interval between first and second doses of mRNA vaccines was 3-4 weeks. Thus, staff members may need to receive their first vaccine dose four weeks in advance of the enforcement date in order to be in compliance.

An event study approach does not require that that baseline levels of outcome variables be the same between treated and control units. Instead, it requires "parallel trends," meaning that, on average, the treated units would have followed the same trends in outcomes as the control units had the treated units not been treated. This assumption is inherently untestable since we do not directly observe the counterfactual in which treated units were not treated. However, our estimates do allow us to probe the plausibility of parallel trends. By inspecting the pre-treatment η_k (i.e., $\{\eta_k\}_{k<0}$), we can assess whether treated and control units followed parallel trends prior to the intervention. Insofar as these coefficients do not indicate violations in parallel trends prior to treatment, it suggests that the parallel trends assumption is plausible.

Post-treatment coefficients of η_k (i.e., $\{\eta_k\}_{k\geq 0}$) represent the estimated effect of the mandate on the outcome variables in event-period k relative to the reference period. If pre-trends are similar, violation of the parallel trends assumption would only occur if there were unobserved systematic shocks to outcomes that are contemporaneous to the mandate. We probe this possibility in our robustness analyses.

We present our findings from this analysis in the subsequent subsections and summarize the estimates in Table A5.

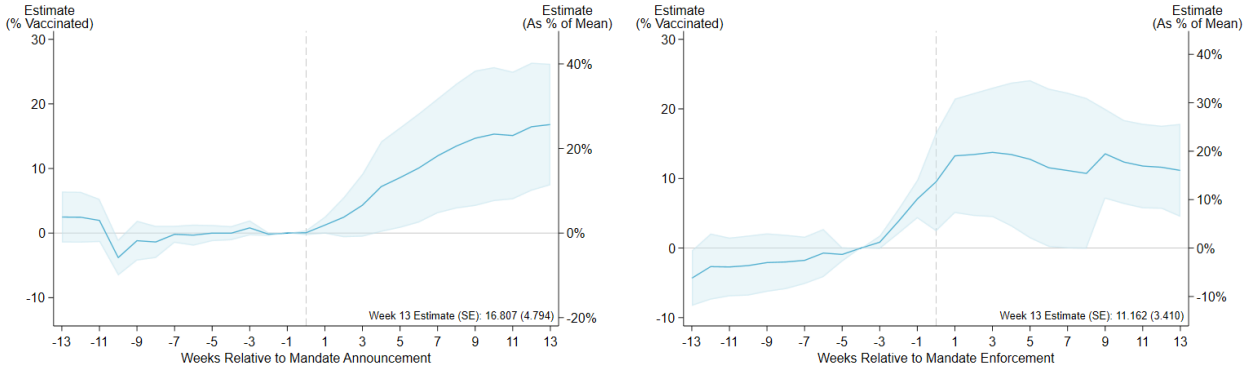
5.1 Staff Vaccination Rates

We first examine the effects of employee vaccination mandates on staff vaccination rates. If fully effective, a mandate should result in all staff being vaccinated. However, it's possible that many employees were able to opt-out or that mandates were not strictly enforced. Therefore, it is worthwhile to assess extent to which mandates actually increased vaccination coverage. Figure 1 shows the estimated effects for each event week (η_k) relative to announcement (panel a) and enforcement (panel b). Relative to contemporaneous changes in control facilities, vaccination at treated facilities increased steadily after the mandate announcement. On average, facilities announcing a mandate saw an increase in vaccination coverage of an additional 16.81 percentage

points (25.68% of the mean) relative to controls by the 13th week after mandate announcement. These estimates suggest that employer mandates were highly effective at increasing vaccination coverage of nursing home staff within a few months of announcement. Our event study estimates show no pre-trends in staff vaccinations, implying that prior to the mandate, both treated and control facilities were experiencing similar trends in staff vaccination.

Figure 1: Effect of Mandates on Staff Vaccination Rates

(a) Mandate Announcement **(b) Mandate Enforcement**



Notes. These figures plot stacked event study regression estimates comparing treated nursing homes that implemented a vaccination mandate relative to control nursing homes that did not implement a vaccination mandate. Regressions include nursing home and week fixed effects. Standard errors are clustered at the chain level. Estimates in (a) are computed relative to a baseline one week prior to mandate announcement. Estimates in (b) are computed relative to a baseline week that is four weeks prior to the mandate becoming enforced. Four weeks was the authorized interval between first and second dose for the Moderna vaccine. The left axes present the estimates, and the right axes present the estimates scaled by the mean of the outcome variable for treated nursing homes in the baseline week. The mean staff vaccination rate in the week prior to mandate announcement was 65.46% (standard deviation [SD]= 15.43). The mean staff vaccination rate in the four weeks prior to mandate enforcement was 69.60% (SD= 14.38). The estimate in the lower-right corner is the effect of the mandate 13 weeks post mandate announcement (or enforcement). N = 2,180,108 facility-weeks in panel (a) and N = 1,610,603 facility-weeks in panel (b).

Panel (b) shows an extremely sharp increase in vaccination at mandate facilities in the four weeks leading up to mandate enforcement. This pattern is highly consistent with a rush to meet the compliance deadline, especially given the four week timeline for receiving a full dose of the Moderna vaccine.[5] The gap in vaccination then flattens out at 13.26% almost immediately after the enforcement date, further confirming that the estimated increase is attributable to staff aiming to meet the compliance deadline.[6]

5.2 Protective Effects of Increased Staff Vaccination

The mandate-induced increase in staff vaccination in Section 5.1 could provide protection that significantly reduces the spread of COVID-19 among the nursing homes' residents and staff. Vaccinated staff are both less

[5] Note that the slight pre-trends in Panel (b) are expected and likely represent staff coming into compliance after announcement but well before the enforcement deadline. That vaccination increases particularly sharply immediately prior to the deadline suggests a clear effect from staff trying to meet the deadline.

[6] It is worth noting that while we find the mandates to be highly effective, our estimates do not show treated facilities as achieving 100% vaccination coverage even after the enforcement deadline. This likely reflects imperfect enforcement and the ability of employees to seek religious, medical or other waivers.

likely to contract COVID themselves (Polack et al., 2020) and are less likely to spread it to other staff and residents even when they do (Prunas et al., 2022). Indeed, previous research has shown that nursing homes with higher staff vaccination rates fared much better under the Delta Variant infection waves (McGarry et al., 2022*b*).

In this section, we estimate the protective effects of additional vaccination. For this question in particular, the epidemiological nature of COVID spread makes selection into treatment a particular concern. Specifically, nursing homes experiencing recent or current outbreaks might be more likely to enact staff vaccination mandates. As previously noted, the event study methodology relies on a parallel trends assumption and does not require pre-treatment levels of outcome variables be the same across treatment and control groups. However, for epidemiological outcomes in particular, pre-treatment outcome levels may affect the plausibility of the parallel trends assumption. For example, a facility with a large number of COVID cases immediately prior to mandate announcement may be in the middle of an outbreak. The continuation of this pre-existing outbreak is likely to be the primary driver of trends in the facilities' COVID-related outcomes—such as cases and deaths—in the subsequent weeks. Alternatively, recent outbreaks could also confer higher levels of naturally-acquired immunity among the facility's residents and staff, making it less susceptible to new outbreaks in the future. Therefore, a COVID-naive facility—i.e., one without recent large outbreaks—would make a poor control for a facility that recently experienced an outbreak or that is currently in the middle of one.[7] Insofar as the timing of mandates may be driven by prior or ongoing outbreaks, this could lead to violations of the parallel trends assumption.

To address this potential concern, we follow McGarry et al. (2024) by restricting our sample for this analysis to facilities that did not have a COVID-19 outbreak during the 10 weeks prior to mandate announcement. Our primary specification is to exclude both treatment and control facilities that had more than one case during this window, as the CDC required facilities to report having multiple cases as an outbreak (Franklin et al., 2024). Importantly, this means that estimates in this analysis reflect the protective effects of mandates for facilities that have not had a recent outbreak.[8] Appendix A.4 contrasts our restricted sample with the full sample, and we show in Appendix B.4 that our findings are robust both to excluding facilities with any recent cases and to excluding facilities with three or more recent cases.

Additionally, if mandates are implemented because of anticipated outbreaks this could also lead to violations in parallel trends. Most plausibly, this might occur if mandates are implemented during times when COVID-prevalence in the local community is high. Indeed, COVID outbreaks are highly correlated across

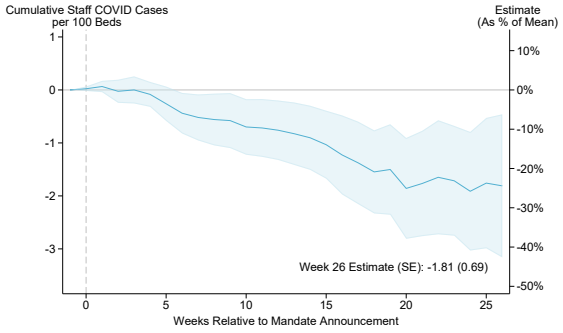
[7] Likewise, a facility in the middle of an outbreak or that experienced a recent outbreak would make a poor control for a COVID-naive facility.

[8] For excluded facilities, the protective effects of mandates might plausibly be smaller or larger. They would be smaller if, for example, recent outbreaks confer sufficient acquired immunity. On the other hand, they could be larger if, for example, recent outbreaks are a sign that a facility has poor infection control and is therefore likely to have outbreaks in the future.

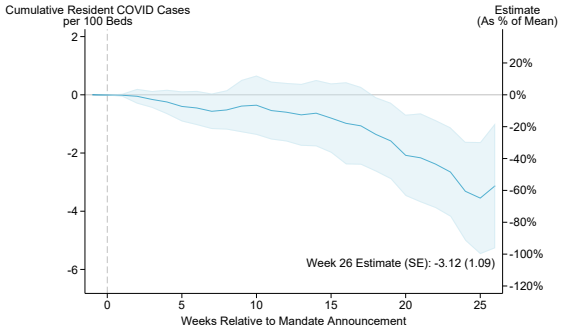
facilities within a geographic area, as they are likely seeded by staff who contract it from the community or from other facilities (Chen, Chevalier and Long, 2021; McGarry et al., 2021*a*; Shen, 2022). We therefore address potential bias due to differences in community spread by allowing the time trends in our regression to be county-specific in this analysis. Finally, because transmission may occur from patients and staff vaccine mandates could indirectly increase resident vaccination rates (e.g., through additional onsite vaccination clinics), we also include controls for resident COVID vaccination rates. Our findings are robust to excluding these controls.

Figure 2: Effect of Mandate Announcement on COVID-19 Cases and Deaths

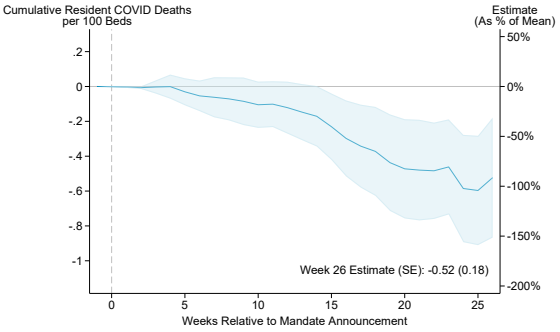
(a) Staff Cases



(b) Resident Cases



(c) Resident Deaths



Notes. These figures plot cumulative stacked event study regression estimates obtained from the subgroup of nursing homes that did not have a Covid-19 outbreak (i.e., fewer than 2 total Covid-19 cases among residents and staff) in the 10 weeks prior to mandate announcement. Treated facilities are those that implemented a chain-level mandate and control facilities are those that did not. Details on the stacking and the estimates from the non-cumulative event study, including pre-treatment estimates, are provided in Appendix B.1. Regressions include nursing home and county-by-week fixed effects, as well as controls for the percent of residents with completed doses of a Covid-19 vaccine and its quadratic term. Standard errors are clustered at the chain level. Estimates are computed relative to a baseline one week prior to mandate announcement. The left axes present the estimates, and the right axes present the estimates scaled by the mean of the outcome variable for study sample in the last week of follow-up. N=64208 facility-weeks.

Figure 2 presents our estimates on how the epidemiological path of mandate facilities without a recent outbreak differed after mandate announcement relative to non-mandate facilities without a recent outbreak. The estimates imply that the increased vaccination caused by mandates provided substantial protection against COVID outbreaks. First, we estimate that employer mandates resulted in 1.81 fewer staff COVID

cases per 100 beds in the twenty-six weeks after mandate announcement, which is a reduction of 24.41% of the mean. The mandates also had dramatic spillovers for resident health: 3.12 fewer resident COVID cases per 100 beds, a reduction of 56.99% of the mean.

Reductions in cases among nursing home residents can have substantial health impacts given that residents' age, frailty, and comorbidities made them comparatively likely to have severe cases resulting in lasting health effects or even death. Indeed, we find that employer-imposed mandates reduced patient COVID deaths by 0.52 per 100 beds, a reduction of 90.86% of the mean. Since the average facility is about 100 beds, the results mean that the mandates saved one patient life for every two facilities that issued a mandate. Put another way, patients admitted to nursing homes without a mandate were nearly twice as likely to die of COVID than patients admitted to nursing homes that did implement a mandate.[9]

In sum, we estimate protective effects of mandates that quite large. While large protective effects of staff vaccination are in line with previous research (McGarry et al., 2022*b*), it is important to emphasize that our approach only estimates average treatment effects on the treated for the subsample of facilities that did not have a recent outbreak prior to announcing their mandate. Specifically, the protective effects of staff vaccination may be particularly large at these facilities since their relative COVID-naivete likely means that their residents and staff have less acquired naturally-acquired immunity.

5.3 Employment Outcomes

Sections 5.1 and 5.2 showed that employer-imposed mandates were highly effective at increasing vaccination among healthcare workers and providing protection to both patients and staff. However, the imposition of a mandate could lead to greater turnover or even shortages. In this section, we examine whether this is the case among CNA staff, who both constitute the majority of workers and have the lowest vaccination rates. Note that for this this and all remaining analysis, we return to the full sample of control group nursing homes.

Figure 3 shows the effect of employer-imposed mandates on two key employment outcomes for CNAs. Panel (a) shows the effects on the number of CNA staff working each week. These provide the most direct evidence on the extent to which employer-imposed mandates lead to separations and a reduction in the number of workers. By thirteen weeks after announcement, the typical 100 bed facility sees a reduction of about 0.41 CNAs, which represents a reduction that is 2.25% of the mean and significant at the 10% level.

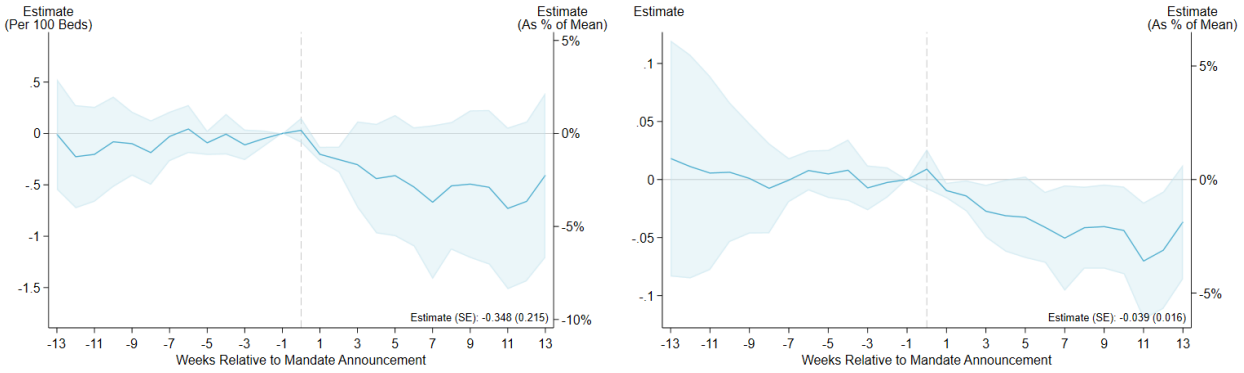
Figure 3 panel (b) shows the effect on the total number of hours worked by CNAs. In order to adjust for variation in census across facilities and within facility over time, we follow common convention used by CMS and researchers in normalizing hours by the number of patient-days.[10] The effect on hours is also negative.

[9] Note that these results do not appear to be driven by changes in resident vaccination rates (Figure B59).

[10] Since occupancy varies over time, some of the estimates in panel (3b) may derive from changes in occupancy. However, we show in Figure B62 that occupancy does not change dramatically after announcement of a mandate. We also show estimates in Figure B63 that are normalized by facility size. While we observe a similar pattern to panel (b) of Figure 3, the estimates

Figure 3: Effect of Mandate Announcement on CNA Staffing Levels

(a) Staff Size **(b) Hours Per Patient Day**



Notes. These figures plot stacked event study regression estimates comparing treated nursing homes that implemented a vaccination mandate relative to control nursing homes that did not implement a vaccination mandate. Regressions include nursing home and week fixed effects. Standard errors are clustered at the chain level. Estimates are computed relative to a baseline one week prior to mandate announcement. The left axes present the estimates, and the right axes present the estimates scaled by the mean of the outcome variable for treated nursing homes in the baseline week. The mean staff size per 100 beds in the week prior to mandate announcement was 18.11(SD= 5.33). The mean hours per patient day in the week prior to mandate announcement was 1.96(SD= 0.47). The pooled estimate in the lower-right corner provides the difference between the post- and pre-treatment average coefficients. N = 2,851,486 facility-weeks. Estimates relative to mandate enforcement are shown in Figure B60.

By 13 weeks after mandate announcement, patients receive an average of 0.04 hours per day less direct care, which is a significant reduction of 1.89% of the mean.

Perhaps the most important takeaway from these estimates is that even where statistically significant, they are quite modest relative to the dramatic turnover and shortages that many feared. They are also much smaller than the effects on vaccination rates, cases, and deaths estimated in Sections 5.1 and 5.2.

Still, even modest changes in staffing can be meaningful to some facilities. As such, we examine the nature if these changes in greater detail in Figure 4, which estimates effects separately for full-time (35+ hours per week), part-time (20-34 hours per week), and very-part-time staff (less than 20 hours per week). These estimates show that reductions in staff and hours were concentrated entirely among part-time and very part-time employees. In contrast, the estimated effect on the number of full-time staff was positive but statistically insignificant, and the estimated effect on hours of care from full-time staff was positive and on the margin of statistical significance at the 10% level. Given the marginal statistical significance, one must interpret these estimates cautiously. However, they are consistent with facilities having increased hours of care from full-time staff to compensate for reduced part-time and very-part-time staffing.

That reductions in staffing were concentrated among part-time and very-part-time staff suggests that employees working fewer hours were more willing to separate over the mandate. This may reflect that the financial value of the employment relationship is smaller for low-hours workers. It may also reflect the

are less precise. These finding are consistent with some of the reduction in hours per patient day deriving from facilities reducing staffing more when occupancy decreases or else increasing staffing less when occupancy increases.

Figure 4: Effect of Mandate Announcement on CNA Staffing Levels by Staff Type

Notes. These figures plot stacked event study regression estimates comparing treated nursing homes that implemented a vaccination mandate relative to control nursing homes that did not implement a vaccination mandate. Regressions include nursing home and week fixed effects. Standard errors are clustered at the chain level. Estimates are computed relative to a baseline one week prior to mandate announcement. The left axes present the estimates, and the right axes present the estimates scaled by the mean of the outcome variable for treated nursing homes in the baseline week. The pooled estimate in the lower-right corner provides the difference between the post- and pre-treatment average coefficients. Full-time staff are those working 35+ hours per week, part-time staff are those working 20-34 hours per week, and very part-time staff are those working fewer than 20 hours per week. N = 2,863,409 facility-weeks.

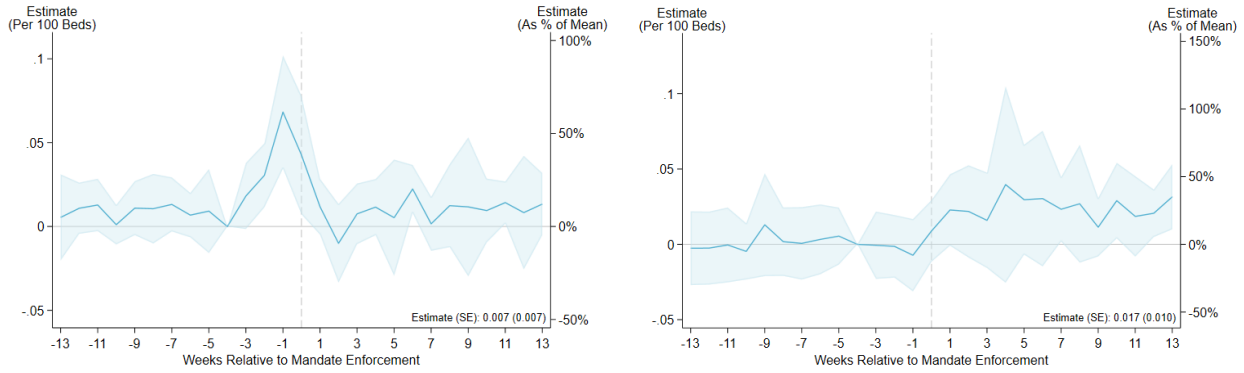
likelihood that many low-hours workers also work additional jobs with other employers either inside or outside of the nursing home industry, mitigating the risks of separating from an employer imposing a mandate.

The difference in effects for full- and part-time workers suggests that workers' outside options might mediate employment effects. We investigate this further in Appendix B.11 by contrasting effects in concentrated (above-median HHI) and competitive (below-median HHI) labor markets. Unfortunately, our estimates are noisy relative to the small average effect size: the confidence intervals are sufficiently large that we are not able to statistically distinguish the estimates in either subsample from zero, nor are we able to distinguish the estimates across the subsamples. Therefore, we are only able to reject large differences in effects by market concentration. That differences in effects between full- and part-time workers are much more distinguishable suggests that workers' relationship with their employer may be a more important factor in compliance than the industry-specific level of labor market competition.[11]

[11] This would be true if, for example, the outside option for many part-time CNAs was to stop working or to work outside of the nursing home industry.

Figure 5: Effect of Mandate Enforcement on CNA Separations and Hiring

(a) Separations **(b) Hires**



Notes. These figures plot stacked event study regression estimates comparing treated nursing homes that implemented a vaccination mandate relative to control nursing homes that did not implement a vaccination mandate. Regressions include nursing home and week fixed effects. Standard errors are clustered at the chain level. Estimates are computed relative to a baseline week that is 4 weeks prior to the mandate becoming enforced. Four weeks was the authorized interval between first and second dose for the Moderna vaccine. The left axes present the estimates, and the right axes present the estimates scaled by the mean of the outcome variable for treated nursing homes in the baseline week. The mean number of separations per 100 beds in the week prior to mandate enforcement was 0.11(SD=0.16). The mean number of hires per 100 beds in the week prior to mandate enforcement was 0.09(SD= 0.18). The pooled estimate in the lower-right corner provides the difference between the post- and pre-treatment average coefficients. Estimates relative to mandate announcement are shown in Figure B61. N = 1,712,879 facility-weeks.

Finally, Figure 5 shows some of the channels and time dynamics by which our estimated staff reductions occur by separately examining separations and hires.[12] Panel (a) shows a marked spike in separations at mandate facilities at the time of mandate enforcement, indicating that some non-compliant employees worked at the facility up until the mandate policy forced them to depart. Panel (b) shows a less sharp increase in hiring at mandate facilities in the weeks following mandate enforcement. The weekly coefficients are not significant at the 5% level since the effects on additional hiring are likely spread out over many weeks. However, the point estimates are suggestive of facilities slightly increasing hiring after enforcement to replace workers who separated due to the mandate.

Notably, for the small number of separations that we do observe, we cannot distinguish whether these are voluntary separations to avoid the mandate or involuntary separations for non-compliance. This limits our ability to identify the exact mechanism through which staffing turnover occurs, and it prohibits us from examining the possibility that facilities adopted mandates strategically in an effort to, for example, reduce part-time staff or compel uncooperative employees to quit. Nevertheless, these limitations do not alter our interpretation—firm-level vaccine mandates produce sizable increases in vaccination rates with small increases in employee turnover.

The Appendix reports numerous other employment-related results. These include results for RNs and LPNs

[12] We identify separations in the PBJ by an employee ID ceasing to appear at a facility and hires by an employee ID appearing at a facility for the first time.

(Appendix B.9), results by employee tenure (Appendix B.10), results for contract workers only (Appendix B.8), and results that constrain the control group to include only chain facilities (Appendix B.6). None of these results meaningfully alter our conclusions. Where they deviate, we typically either observe even smaller effects on staffing or slightly larger standard errors.

5.4 Measures of Patient Care

Section 5.3 suggests that employer-imposed vaccine mandates reduced nursing home staff size and hours from part-time and very-part-time staff. These reductions were quite modest, amounting to approximately 2 minutes of CNA care per patient day. However, given the demonstrable importance of staffing (Friedrich and Hackmann, 2021), even modest reductions could plausibly impact care. Moreover, it's possible staff who complied with the mandate continued to work a similar number of hours but did so with less effort than before. This, too, would result in lower quality care and harms to patients.

We investigate these possibilities in Figure 6, which shows the effect of mandate enforcement on six adverse patient outcomes thought to be associated with poor quality care resulting from insufficient nursing home staffing levels. Most estimates are close to zero and are not statistically significant. Notably, we do observe a slight increase in bladder incontinence, which could reflect less attention being paid to residents' bodily needs. CNAs, in particular, are needed to provide physical assistance with toileting for many residents. We also see some evidence of a marked increase in use of physical restraints in the quarter after mandate enforcement. This is consistent with new, overburdened, or disgruntled staff relying on physical restraints to deal with patients exhibiting behavioral issues. However, our estimates on physical restraints are quite imprecise and exhibit relatively large standard errors.

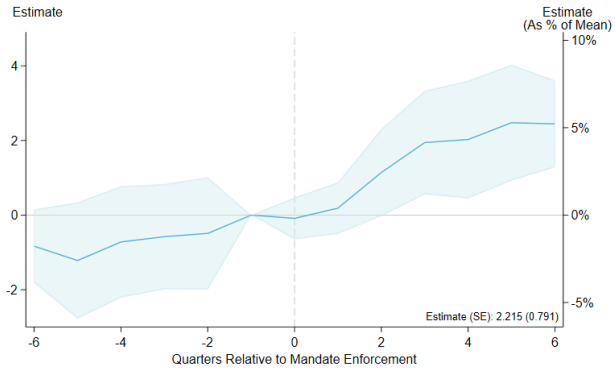
Overall, our estimates do not suggest that patient care suffered dramatically. The relatively small estimated degradation in care pales in comparison to the dramatic positive health effects of increased protection for the facility against COVID-19 outbreaks (Section 5.2). These results are supported by analyses in Appendix B.13 showing the impact of mandate announcement and enforcement on health inspection outcomes, where no significant results were found.

5.5 Robustness Checks

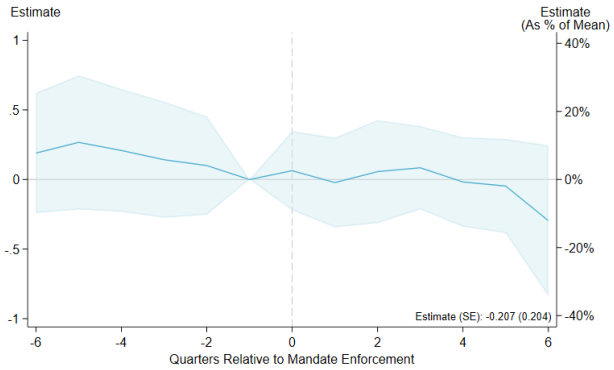
We summarize the many robustness checks and sensitivity analyses that can be found in the Appendix and further describe additional robustness checks and heterogeneity analyses in this section. Our results are robust to restrictions that address potential confounding from state and federal mandates (Appendix B.2), excluding control facilities geographically near treated facilities (Appendix B.3), alternative definitions of recent COVID-19 outbreaks used to construct the COVID naive subsample (Appendix B.4), running analyses

Figure 6: Effect of Mandate Enforcement on Adverse Patient Events

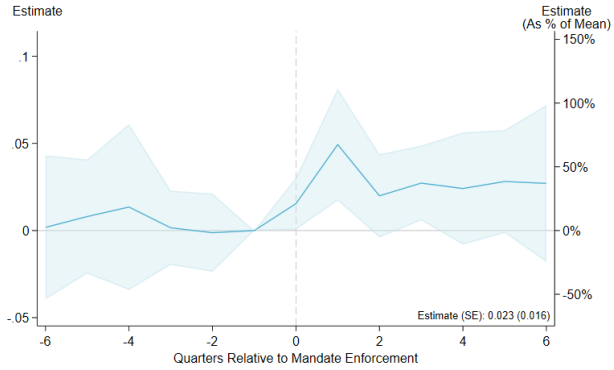
(a) Bladder Incontinence



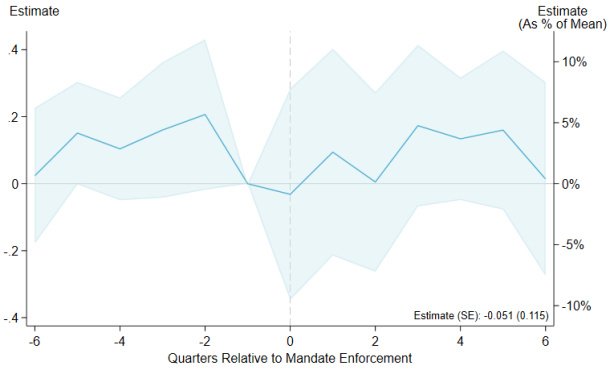
(b) Urinary Tract Infection



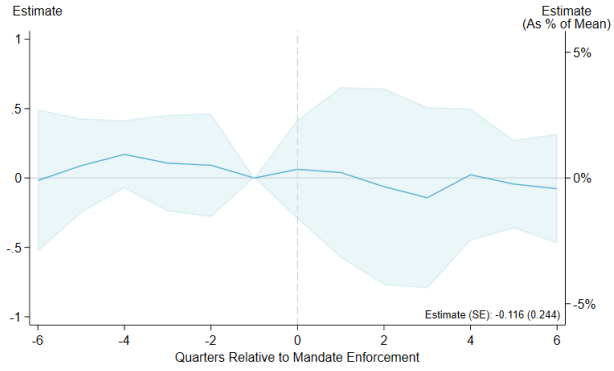
(c) Physically Restrained



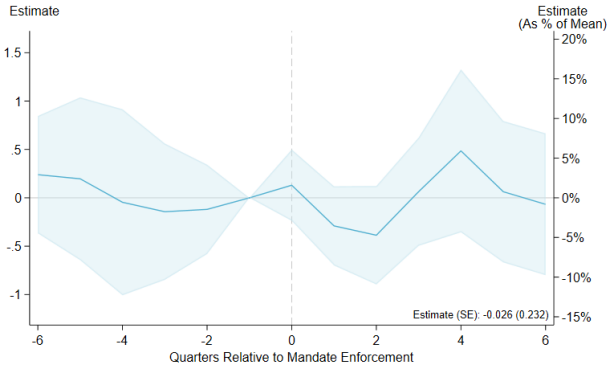
(d) 1+ Falls with Major Injury



(e) Anti-anxiety or Hypnotic Medication



(f) Pressure Ulcer



Notes. These figures plot stacked event study regression estimates comparing treated nursing homes that implemented a vaccination mandate relative to control nursing homes that did not implement a vaccination mandate. Regressions include nursing home and quarter fixed effects. Standard errors are clustered at the chain level. Estimates are computed relative to a baseline quarter that is one quarter prior to the mandate becoming enforced. The study period includes facility-quarters from 2019q3 through 2023q1. The left axes present the estimates, and the right axes present the estimates scaled by the mean of the outcome variable for treated nursing homes in the baseline week. The pooled estimate in the lower-right corner provides the difference between the post- and pre-treatment average coefficients. All estimates are for nursing home long-stay residents. N = 398,856 facility-quarters in panel (a), N = 649,049 facility-quarters in panel (b), N = 654,384 facilty-quarters in panel (c), N = 654,500 facility-quarters in panel (d), N = 641,798 facility-quarters in panel (e), and N = 582,465 facility-quarters in panel (f).

using the COVID-naive sample (Appendix B.5), and restricting the control group to chain-owned facilities only (Appendix B.6). In addition, we present the control group means in Appendix B.7. We also report estimates separately for CNA contract workers (Appendix B.8) and samples of RNs and LPNs (Appendix B.9) to assess how mandate effects differ across employment arrangements. Additional heterogeneity analyses examine staffing effects by employee tenure (Appendix B.10), local labor market conditions (Appendix B.11), mandates announced early versus late (Appendix B.12), and mandate effects by CMS quality ratings (Appendix B.13). Finally, Appendix B.14 collects additional results referenced throughout the paper.

6 Discussion

We find that employer-imposed vaccination mandates were highly effective at protecting patient health at nursing homes by inducing staff to vaccinate, and that mandates carried very small costs in terms of both staff turnover or reductions in patient care. To our knowledge, this is the first study to show that an employer-imposed mandate meaningfully improves patient health and reduces death without significant employment effects among staff, even when competing facilities do not issue their own mandates.

Our paper contains several notable empirical findings. First, our estimates show sizable increases in staff vaccinations in the weeks following mandate announcement and enforcement (16.81 and 11.16 percentage points, respectively). This is substantially more effective than research has found persuasion-based approaches such as education, outreach and small-scale incentives.

The protective effects of this additional vaccination coverage are even more dramatic: our estimates imply that the typical 100 bed nursing home that implemented a mandate experienced 1.81 fewer staff cases, 3.12 fewer resident cases, and 0.52 fewer resident deaths in the 26 weeks after mandate announcement. This suggests that unwillingness by health care managers to impose mandates can carry significant costs in terms of patient mortality. A back-of-the-envelope extrapolation of our estimates to the entire population of nursing homes in the U.S. suggests that had all of the approximately 15,000 US nursing homes adopted vaccine mandates at the time of the first adopter, nearly 7,500 patient lives could have been saved. If effects are similar across hospitals, assisted living facilities, and other types of health care facilities, employer-imposed mandates might have had the potential to save an even greater number of lives.

An important limitation of our paper is that the estimated effects on COVID-19 health outcomes are not necessarily generalizable to all nursing homes, let alone to other healthcare providers. Our estimated effects on COVID-19 health outcomes are identified from the subgroup of facilities that had not had a recent outbreak at the time of mandate announcement. While this restriction increases the credibility of the parallel trends assumption, it also necessarily creates a tradeoff in the generalizeability of our estimates to facilities that are not relatively COVID-naive. The unknown effects of a mandate on facilities with recent

outbreaks might plausibly be larger or smaller than those that we estimate. On one hand, facilities with a recent outbreak may have greater naturally-acquired immunity, weakening the protective effects of mandates. On the other hand, the fact that a facility had a recent outbreak means it may have weaker infection control practices, suggesting that the potential for future outbreaks—and therefore the potential benefits of additional vaccination coverage—may be larger. Regardless, our estimates do demonstrate substantial value to announcing employer-imposed mandates prior to outbreaks occurring.

In contrast to the large effects on vaccination rates and COVID-19 health outcomes, we estimate that employer-imposed mandates resulted in only modest reductions in CNA staffing and hours. Separations were more likely among staff working fewer hours. Furthermore, our findings suggested that facility managers were able to handle the small number of employee separations by increasing reliance on full-time staff and hiring new staff in the weeks after the mandates were enforced. We found few measurable adverse impacts on patient care or performance on health inspections, likely because the reductions in care hours per patient was so minimal. These limited effects fell far short of the industry-wide fear that employer-imposed vaccination mandates might result in mass quitting by vaccine-hesitant staff and a cascade of negative consequences for patient care.

It is worth highlighting that mandate-adopting facilities were located in wealthier areas and served resident populations that were more white. This descriptive fact indicates that the protective benefits of employer-issued mandates disproportionately accrued to traditionally-advantaged groups, potentially exacerbating persistent inequalities in health and long-term care. Resolving inequality in health care provision and health care outcomes is one of the most challenging issues facing the medical profession (Antwi, Aouad and Blascak, 2023), and our paper details another channel through which unequal outcomes may occur.

6.1 Implications for Managerial Practice

Our paper has several important implications for managers of health care facilities. First, the results suggest that managerial policies can and do substitute for public policy decisions. As noted previously, many health care managers preferred that governments, not firms, make decisions around issues such as mandated vaccination, but when governments cannot or do not make such decisions, our results suggest managerial decisions can have measurable impact. This suggests that managers should not necessarily wait for slow and often controversial government-level decisions around mandates and other similar decisions (Drew, 2022), particularly as public response to choices around vaccination become more heterogeneous. Indeed, the uptake of COVID booster shots by the public is extremely small, and COVID-19 is now a regular threat to the health of frail older adults as an endemic infectious disease. Furthermore, future COVID variants, unknown future transmissible viruses, and the possibility of other pandemics all point to the importance of our study's results

on policies by health care managers. Simply put, managers play an increasing role in health care policy.

Our findings also contribute to the management literature on organizational resilience and workforce design. A longstanding question in operations management concerns how organizations can maintain performance when faced with external shocks or internal policy changes that affect labor availability. The nursing homes in our setting appear to have absorbed modest turnover without meaningful deterioration in monitored quality outcomes, suggesting a degree of latent operational flexibility. This resilience may reflect substitution across workers, schedule redesign, the strategic use of staffing slack, or the concentration of exits among peripheral rather than core employees. For managers, this points to the importance of workforce composition—not simply staffing levels—as a determinant of organizational adaptability, and highlights the need to understand which workers are most likely to separate from their position when faced with additional costs of employment.

Importantly, the implications of this study extend beyond health care to a broader class of organizational decisions involving workforce mandates, compliance requirements, and safety-oriented operational redesign. Firms in sectors ranging from transportation and logistics to education and manufacturing routinely confront choices about whether to impose policies that may generate employee resistance but improve system reliability, safety, or continuity of service. Our findings suggest that managerial concerns about labor market disruption should be evaluated against the organizational capacity to reallocate work and against the potentially large benefits of reducing operational risk. For management science, this reinforces the value of integrating labor economics, operational resilience, and risk management into a unified framework for studying organizational policy adoption.

6.2 Theoretical Implications

This paper also has theoretical implications on one of the fundamental phenomenon studied by labor economists since Lazear (2000): the role of employee sorting. Traditional agency-theoretic models of incentives in the workplace, inspired by Holmström (1979), focus on how incentives affect employee effort. Spurred by Lazear's finding that the effect of incentives is determined at least as much by sorting—the decisions of employees of a given type to join or leave a company based on the incentive system used—more recent work has focused less on effort and more on attracting and retaining the right employee. This paper found that separations were concentrated among part-time workers. Although we do not have data to investigate if these employees performed worse than full-time workers, the lack of evidence in reduced patient care even after their separation is at least weakly suggestive of the fact that full-time workers may be "better" in some important sense. Just as the monetary rewards for performance in Lazear led to sorting by quality, with good employees sorting in and bad ones sorting out, the negative reward of a coercive mandate may actually have similar effects. This is a speculative but fascinating avenue for future research.

6.3 Future Directions

We hope this paper will spur further investigation into mandates for vaccines and other employee actions that are clearly tied to patient health and/or organizational safety. There are many employer settings that involve close proximity of employees to each other or customers in constrained spaces, including assisted living facilities, hospitals, schools, prisons, mines, manufacturing plants, and even hospitality businesses such as restaurants, discos, movie theaters and sporting venues. Based on recent history, we cannot necessarily expect government policy makers to act quickly or decisively to protect workers and customers in every situation. This underscores the importance of our main finding: mandates by private organizations can and do make a difference.

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Appendices

A Supplementary Details on Data and Methods

A.1 Vaccination Mandates

A.1.1 Chain Mandates

Data on chain mandates was collected from December of 2020 through September of 2021, following the first public announcement of a company-wide COVID-19 vaccination mandate on December 28, 2020. The process for identifying and verifying nursing home chains that implemented COVID-19 vaccination mandates for all employees was as follows. Given the groundbreaking nature of these mandates, a well-known online publication for senior living (McKnights) reported and updated such announcements weekly. We reviewed this and other sites publishing vaccine mandate announcements for updated chain listings. They then searched and collected links to public announcements from each chain to verify, or searched the chain's website for additional information. When further information was not available for verification, the chain's mandate was not added to the verified listing and these chains were excluded from the analysis. We referred to the chains' websites for specific details on the mandates, including the announcement date, enforcement date, and whether it was a mandate for all employees to be vaccinated (excluding medical and religious exemptions).

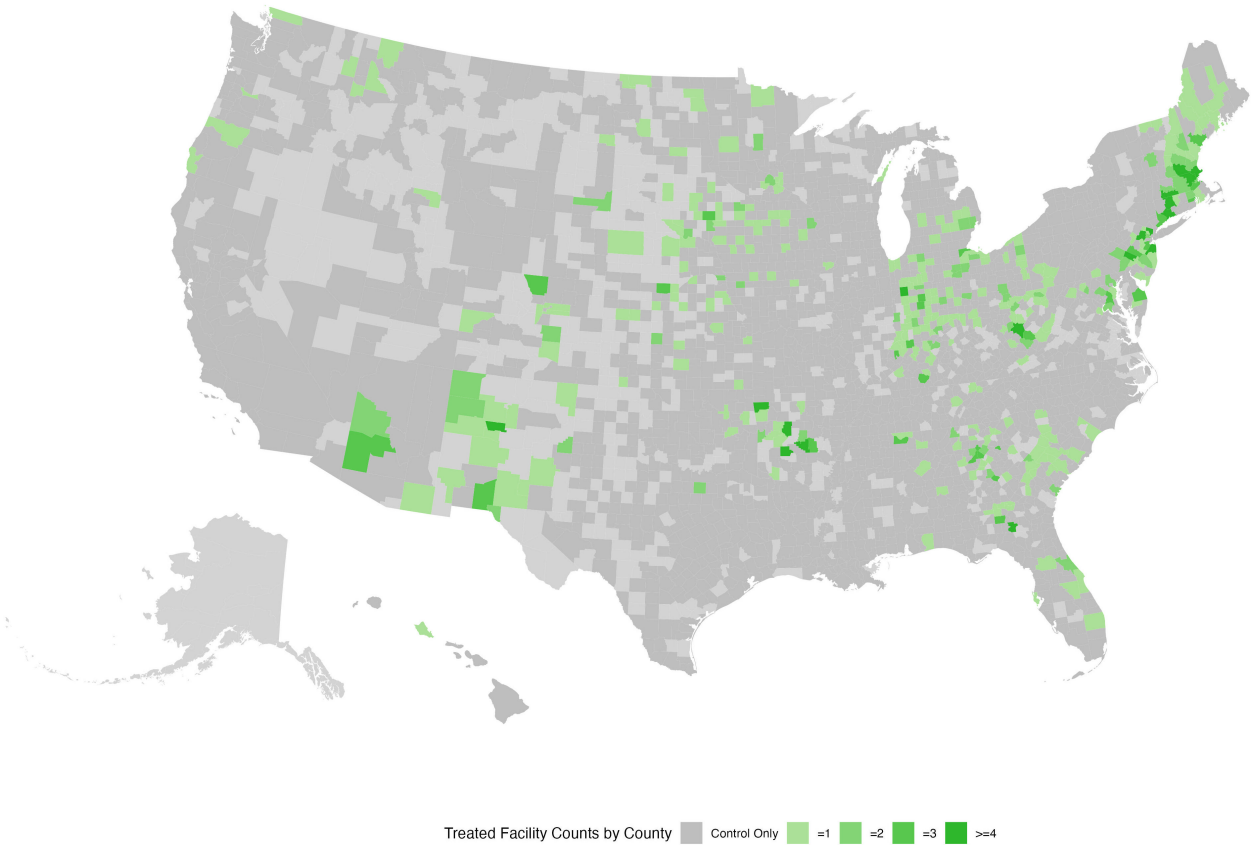
Table A1: Mandate Announcement and Enforcement Dates

Chain	Announcement Date	Enforcement Date
A	December 28, 2020	February 1, 2021
B	March 15, 2021	June 1, 2021
C	March 23, 2021	July 31, 2021
D	March 31, 2021	June 1, 2021
E	May 13, 2021	May 13, 2021
F	June 1, 2021	September 1, 2021
G	July 1, 2021	August 23, 2021
H	July 14, 2021	September 30, 2021
I	July 22, 2021	November 1, 2021
J	August 2, 2021	August 23, 2021
K	August 9, 2021	October 1, 2021
L	August 16, 2021	November 1, 2021
M	August 31, 2021	October 29, 2021

We obtained provider numbers associated with each chain that implemented a vaccination mandate, which allowed us to merge mandate announcement and enforcement dates with our Payroll-Based Journal (PBJ) and National Healthcare Safety Network (NHSN) data. Figure A1 shows the location of mandate and

non-mandate facilities that were included in the sample for employment outcome analyses.

Figure A1: Locations of mandate and non-mandate facilities



Notes. This figure plots the location of mandate (treatment) and non-mandate (control) facilities included in the analyses of employment outcomes. Counties in the lightest gray are those with neither mandate nor non-mandate facilities.

A.2 Additional Details on Outcome Variables

Our outcome data derive primarily from three sources. The first is the National Healthcare Safety Network (NHSN), which was the CDC database where nursing homes were required to record all COVID-19 cases and deaths, as well as the weekly vaccination coverage of their staff and residents. The second is Payroll-Based Journal (PBJ), which contains detailed daily shift-level data for all nursing home workers.[13] The third is CMS Nursing Home Compare data, which include facility characteristics and quality measures, and performances on health inspections. Table A2 summarizes which outcomes come from each dataset.

Staffing Measures The staffing outcomes we analyze are not simply queried from existing databases. Rather, we construct facility-level staffing measures from detailed shift-level PBJ data. As such, we provide additional detail on our staffing outcome measures here.

The staffing outcomes of our analysis include staff size (defined as the total number of unique staff working in a given nursing home each day), staffing levels (measured as the number of hours per resident

[13]CMS also includes a daily occupancy as part of the PBJ. This measure is constructed using the Minimum Data Set.

Table A2: Datasets and Outcomes

Dataset	Outcomes
National Healthcare Safety Network (NHSN) Nursing Home Data	• Staff and resident vaccination rates (percent with completed or partial COVID-19 vaccination) • Staff and resident confirmed COVID-19 cases per 100 nursing home beds • Resident COVID-19 deaths per 100 nursing home beds
Payroll-Based Journal (PBJ)	• Staff hours per 100 nursing home beds • Staff hours per patient day • Staff size (number of unique staff) per 100 nursing home beds • Separations per 100 nursing home beds • Hires per 100 nursing home beds • Occupancy
CMS Nursing Home Compare	• Percent of residents with bladder incontinence • Percent of residents with a urinary tract infection • Percent of residents physically restrained • Percent of residents with falls resulting in major injury • Percent of residents with inappropriate antipsychotic use • Percent of residents with stage II or greater pressure ulcers • Count of deficiencies • Total deficiency score

day), staff separations (measured as the number of employees that are last seen in a given nursing home each day), and staffing hires (measured as the number of employees that are first seen in a given nursing home each day).

The scope of our analysis includes CNA (Certified Nurse Aides), LPN (Licensed Practical Nurses), and RN (Registered Nurses). We combine multiple specific job codes for calculating the employment outcomes of each nurse type based on a Centers for Medicare & Medicaid Services technical documentation (CMS, 2023):

- CNA: Includes Certified Nurse Aides, Aides in Training, and Medication Aides/Technicians
- LPN: Includes Licensed Practical/Licensed Vocational Nurses with Administrative Duties and Licensed Practical/Vocational Nurses
- RN: Includes RN Director of Nursing, Registered Nurses with Administrative Duties, and Registered Nurses

The Payroll-Based Journal provides rich daily shift data on each of these job roles. In addition, it provides daily resident census (i.e., patient count) that CMS constructs using the Minimum Data Set. We use these census measures to normalize staffing levels into hours per resident-day.

All outcomes (with the exception of hours per resident-day) are per 100 beds. We use the number of beds as the denominator specifically because this measure does not change over time. In contrast, a time varying denominator, such as nursing home occupancy, would be problematic because occupancy is likely to be impacted by outbreaks of COVID or other infectious diseases.

A.3 PBJ Data Inclusions and Exclusions

Our analyses of staffing outcomes pertain to nursing home employees since they accounted for the majority of staff; contract workers were excluded. We include nursing homes with 40 or more beds that reported data in the Payroll Based Journal (PBJ) database in 2020 and 2021.

We excluded nursing home with poor quality data reporting in the PBJ database. Table A3 documents the number of mandate and non-mandate nursing homes that were excluded due to poor quality data reporting in PBJ. Nursing homes were excluded if they implemented a software reset, were missing 28+ days of data in 2021, had zero values for staffing outcomes for 7+ days in 2021, or were missing Minimum Dataset census information. For mandate nursing homes, we also excluded nursing homes with no PBJ data available after mandate announcement. Additionally, we excluded all nursing homes belonging to three nursing home chains with a suspected chain-wide software reset in 2019 or 2020. Another chain with an employer vaccination mandate was excluded because of general data quality issues in late 2020.

Additionally, we dropped specific nursing home-days if data quality issues were observed within a two-day window before or after a given day. Such nursing home-days were excluded in 2020 if a nursing home was missing data regardless of length, had zero values for all staffing outcomes for any period, had a temporary decrease in number of workers exceeding 80% from the previous day, or had a MDS census value

of zero or missing. Additionally, nursing home-days were excluded if there was missing data for less than 28 days in 2021. Finally, data was censored if a state-level vaccine mandate for healthcare workers in nursing homes was announced.

Table A3: Inclusion Criteria for Mandate & Non-Mandate Facilities

		Number of Mandate Facilities	Number of Non-Mandate Facilities	Total Number of Facilities (Mandate and Non-Mandate)
Inclusions	40+ beds	786	12,749	13,535
	No missing quarters of data for 2020q2 - 2021q4	739	11,336	12,075
Exclusions	PBJ/software reset	663	9,685	10,348
	28+ days of missing data in 2021	663	9,478	10,141
	Staffing outcomes = 0 for 7+ days in 2021	654	9,271	9,925
	MDS census = missing for > 0 days in 2021	654	9,242	9,896
	Suspected chain-wide software reset	603	9,242	9,845
	Missing PBJ data post mandate announcement	583	9,242	9,825
	Miscellaneous data quality issues	581	9,242	9,823

A.4 Comparison of Treatment and Control Groups

Table A4 displays descriptive characteristics of mandate and non-mandate facilities for the primary analytic sample and the subgroup of Covid-naive facilities. In the full sample, facilities that implemented a mandate were, on average, smaller in both bed and staff size, had lower staff-to-resident ratios, were less likely to be located in urban areas, and had a greater share of Medicare patients. Facilities that implemented mandates had similar 5-star quality scores but worse health inspection scores than facilities without a mandate, suggesting lower-quality care at baseline. Notably, nursing homes with employer-imposed mandates had higher case counts in the 10 weeks prior to mandate announcement. This could reflect that facilities that choose to implement mandates are lower quality or tend to have higher baseline community prevalence. However, it is also consistent with recent outbreaks inducing facilities to opt-in to treatment.

It is important to emphasize that such differences between treated and control facilities do not necessarily invalidate our difference-in-differences approach. Any bias in our estimates would need to stem from differential *trends* between the treated and control groups rather than persistent differences. Epidemiological outcomes, however, are unique in that pre-treatment differences in levels might plausibly lead to post-treatment differences in trends (e.g., due to acquired immunity or ongoing outbreaks).

We address this possibility by restricting the sample to facilities that are relatively COVID-naive in the ten weeks preceding a mandate announcement. When restricting to this subsample, mandate and non-mandate facilities appeared more similar on some dimensions, such as publicly-reported quality measures, but still differ on multiple dimensions, such as size, staffing, and demographics. Most importantly, when restricting to facilities without recent outbreaks, both mandate and non-mandate facilities mechanically have very few pre-treatment cases or deaths. This essentially eliminates the possibility that post-treatment trends differ between mandate and non-mandate facilities due to recent outbreaks. Also comfortingly, both mandate and non-mandate facilities in this subsample have similar vaccination rates for staff.

Table A4: Summary Statistics of Mandate and Non-Mandate Nursing Homes

	Full Sample[a]			Subgroup without Recent Covid-19 Outbreaks[b]		
	Mandate	Non-Mandate	|Diff|/SD	Mandate (Subgroup)	Non-Mandate (Subgroup)	|Diff|/SD
Staff Vaccinated (%)	64.97 (15.03)	62.24 (18.70)	0.18*	64.31 (15.40)	65.20 (18.22)	0.06
Staff size [c, e]	18.10 (5.32)	19.03 (6.79)	0.17*	18.09 (5.37)	18.11 (6.79)	0.01
Hours per Resident Day [d,e]	1.96 (0.47)	2.12 (0.57)	0.35*	1.95 (0.43)	2.02 (0.57)	0.16*
Separations [e]	0.10 (0.15)	0.11 (0.16)	0.05	0.09 (0.14)	0.10 (0.16)	0.09
New Hires [e]	0.08 (0.14)	0.09 (0.16)	0.02	0.09 (0.15)	0.09 (0.17)	0.03
Staff Weekly Confirmed COVID-19	0.28 (1.47)	0.25 (1.08)	0.02	0.02 (0.18)	0.07 (0.36)	0.03*
Residents Weekly Confirmed COVID-19	0.44 (3.02)	0.21 (1.67)	0.08	0.01 (0.12)	0.04 (0.39)	0.01
Residents Weekly COVID-19 Deaths	0.03 (0.26)	0.03 (0.34)	0.00	0.00 (0.00)	0.00 (0.09)	0.02
Beds	100.50 (46.15)	115.17 (62.10)	0.32*	93.90 (46.22)	116.07 (57.99)	0.48*
Medicaid (%)	60.05 (23.09)	61.30 (21.43)	0.05	57.68 (23.57)	60.81 (24.42)	0.14
Medicare (%)	14.28 (12.65)	12.26 (10.65)	0.16*	13.28 (11.71)	12.07 (11.46)	0.10
White (%)	81.50 (22.00)	76.25 (24.37)	0.24*	84.50 (19.90)	72.99 (24.81)	0.52*
Black (%)	10.74 (18.37)	13.34 (18.55)	0.14*	9.91 (17.33)	15.46 (20.13)	0.30*
Household Income (Median)	66601.78 (19552.97)	66983.59 (18573.84)	0.02	65846.01 (20084.16)	73529.32 (18054.53)	0.39*
Urban (%)	0.65 (0.48)	0.70 (0.46)	0.12*	0.44 (0.50)	0.75 (0.43)	0.65*
For Profit (%)	0.76 (0.43)	0.73 (0.45)	0.07	0.58 (0.49)	0.74 (0.44)	0.36*
Star Rating	3.28 (1.33)	3.28 (1.39)	0.00	3.28 (1.34)	3.15 (1.43)	0.10
Deficiency Count	7.24 (5.69)	7.71 (7.07)	0.08	7.61 (5.65)	8.52 (7.52)	0.16*
Deficiency Score	59.82 (94.25)	64.54 (87.01)	0.05	60.30 (84.43)	74.16 (104.56)	0.15*
Bladder Incontinence (%)	46.16 (14.57)	47.11 (18.25)	0.07	47.09 (14.45)	48.04 (19.47)	0.07
Urinary Tract Infection (%)	3.13 (3.68)	2.35 (3.16)	0.21*	3.05 (3.61)	2.12 (3.00)	0.25*
Physically Restrained (%)	0.08 (0.60)	0.18 (1.49)	0.17*	0.08 (0.57)	0.10 (0.73)	0.03
1+ Falls with Major Injury (%)	3.73 (3.34)	3.35 (2.84)	0.11*	3.75 (3.29)	3.20 (2.81)	0.16*
Anti-Anxiety or Hypnotic Medication (%)	17.95 (9.77)	19.81 (10.36)	0.19*	18.00 (9.72)	18.75 (10.21)	0.08
Pressure Ulcer (%)	8.18 (5.31)	8.32 (5.58)	0.03	8.01 (5.18)	8.52 (5.52)	0.10
Facilities	581	9,242		311	1,999	

[a] This sample consists of facilities with high-quality reporting in the PBJ (see Supplementary Appendix, Section 1.2).
[b] This sample consists of the subgroup of nursing homes that were Covid-19 naive, meaning they did not have a recent Covid-19 outbreak (defined as more than 1 cases among residents and staff in the 10 weeks prior to mandate announcement).
[c] Total number of unique staff working in a nursing home each day.
[d] Number of care hours worked by nursing staff per patient.
[e] Reported means are for Certified Nursing Assistants (CNAs) only.
Notes. This table reports means of outcomes and nursing home characteristics followed by the standard deviation. For time varying measures such as health and employment outcomes, the reported means for mandate nursing homes (columns 1 and 4) pertain to the week prior to mandate announcement. Means for the non-mandate nursing homes (columns 2 and 5) are constructed to sample from the same distribution of weeks that the treatment (mandate announcements) occurred in. Data for the percentage of staff vaccinated, employment outcomes, and COVID outcomes are at the week level. Data for nursing home characteristics are at the year level. Data for quality measures and deficiencies are at quarterly level. Matched sample difference is divided by standard deviation of full mandate sample. p value for two sample t-test (two tailed) on the mean difference between matched mandate and non-mandate sample are reported. Significance at 0.05 level.

Table A5: Summary of Estimates

Outcome	Estimate	Confidence Interval
Staff vaccination		
Staff vaccination rate (13 weeks after announcement)	16.807	[7.411, 26.203]
Staff vaccination rate (13 weeks after enforcement)	11.162	[4.479, 17.845]
COVID cases and deaths after announcement (cumulative over 26 weeks)		
Staff cases per 100 beds	-1.810	[-3.160, -0.460]
Resident cases per 100 beds	-3.124	[-5.270, -0.978]
Resident deaths per 100 beds	-0.523	[-0.866, -0.180]
CNA staffing levels after announcement		
CNA staff size per 100 beds	-0.348	[-0.769, 0.074]
CNA hours per patient day	-0.039	[-0.071, -0.007]
CNA staffing levels after announcement by staff type		
Full-time CNA staff size per 100 beds	0.182	[-0.187, 0.551]
Part-time CNA staff size per 100 beds	-0.299	[-0.550, -0.048]
Very part-time CNA staff size per 100 beds	-0.141	[-0.217, -0.065]
Full-time CNA hours per patient day	0.024	[-0.006, 0.054]
Part-time CNA hours per patient day	-0.039	[-0.077, -0.001]
Very part-time CNA hours per patient day	-0.017	[-0.029, -0.005]
Staffing separations and new hires after enforcement		
CNA separations per 100 beds	0.007	[-0.007, 0.021]
CNA new hires per 100 beds	0.017	[-0.003, 0.037]
Adverse patient events after enforcement		
Bladder incontinence	2.215	[0.665, 3.765]
Urinary tract infection	-0.207	[-0.607, 0.193]
Physically restrained	0.023	[-0.008, 0.054]
1+ falls with major injury	-0.051	[-0.276, 0.174]
Anti-anxiety or hypnotic medication	-0.116	[-0.594, 0.362]
Pressure ulcer	-0.026	[-0.481, 0.429]

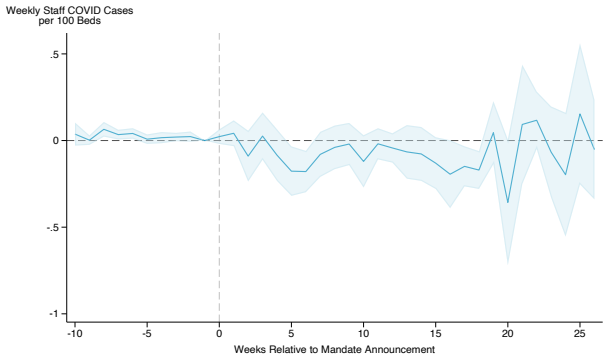
Notes: Estimates summarize end of study period or pooled estimates from Figures 1–6.

B Additional Results and Robustness

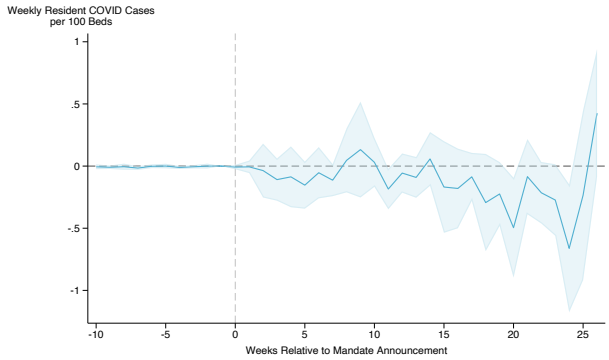
B.1 Weekly Estimates for COVID-related Outcomes

Figure B2: Event Study for COVID Cases and Deaths (Weekly Estimates)

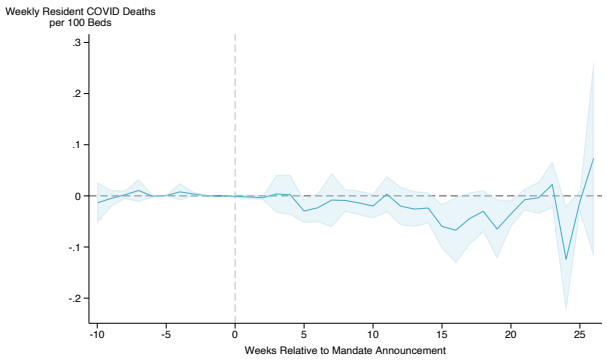
(a) Staff Cases



(b) Resident Cases



(c) Resident Deaths

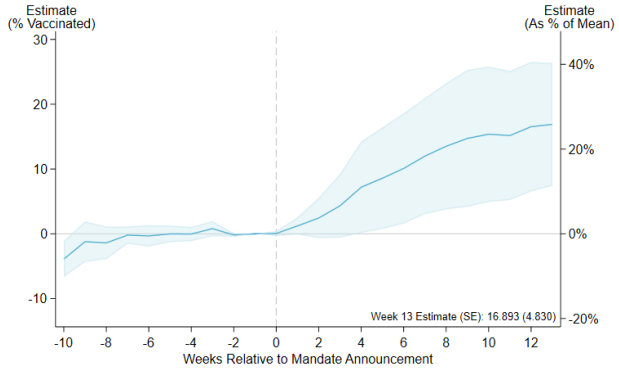


Notes. These figures plot weekly stacked event study regression estimates obtained from the subgroup of nursing homes that did not have a Covid-19 outbreak (i.e., 1 or fewer total Covid-19 cases among residents and staff) in the 10 weeks prior to mandate announcement. Treated facilities are those that implemented a chain-level mandate and control facilities are those that did not. Details on the stacking are provided in the Appendix. Regressions include controls for resident Covid-19 vaccination rates and nursing home and county-by-week fixed effects. Standard errors are clustered at the chain level. Estimates are computed relative to a baseline one week prior to mandate announcement. Estimates for event times >-1 are used to compute the cumulative estimates in Figure 2 in the manuscript. N=64208 facility weeks.

B.2 Alternative Approaches to Addressing State and Federal Mandates

B.2.1 Exclude Mandates Announced After August 18, 2021

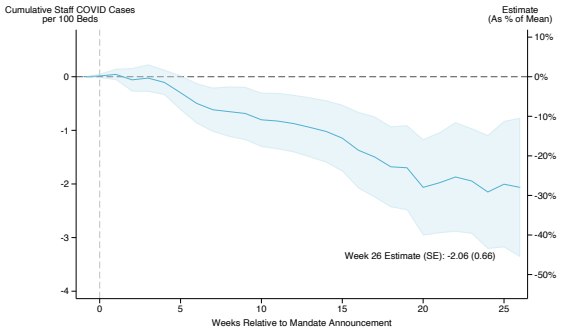
Figure B3: Effect of Mandate Announcement on Staff Vaccination Rates - Excluding Mandates announced between August 18, 2021 and September 9, 2021



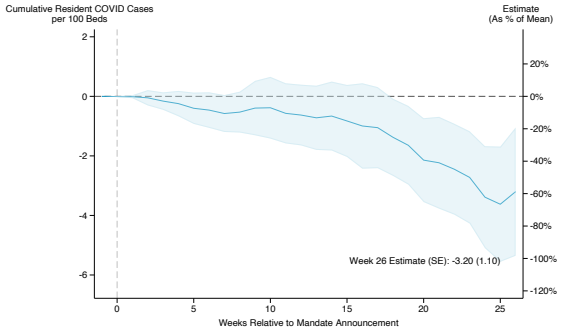
Notes. These figures plot stacked event study regression estimates comparing treated nursing homes that implemented a vaccination mandate relative to control nursing homes that did not implement a vaccination mandate. These results exclude cohorts where treated facilities had a mandate that was announced after August 18, 2021, when facilities may have been aware of the federal intent of establishing a vaccination mandate. Regressions include nursing home and week fixed effects. Standard errors are clustered at the chain level. Estimates are computed relative to a baseline one week prior to mandate announcement. The left axes present the estimates, and the right axes present the estimates scaled by the mean of the outcome variable for treated nursing homes in the baseline week. The estimate in the lower-right corner is the effect of the mandate 13 weeks post mandate announcement.

Figure B4: Effect of Mandate Announcement on COVID-19 Cases and Deaths - Excluding Mandates announced between August 18, 2021 and September 9, 2021

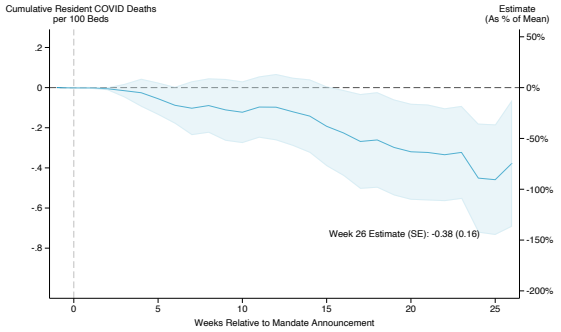
(a) Staff Cases



(b) Resident Cases



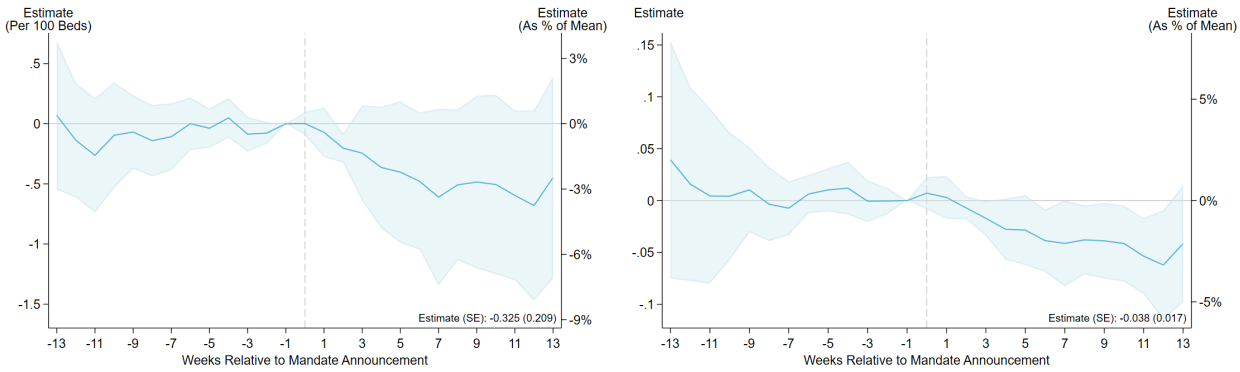
(c) Resident Deaths



Notes. These figures plot cumulative event study regression estimates comparing treated nursing homes that implemented a vaccination mandate relative to nursing homes that did not. These results exclude cohorts where treated facilities had a mandate that was announced after August 18, 2021, when facilities may have been aware of the federal intent of establishing a vaccination mandate. Analyses are restricted to the subgroup of nursing homes that were COVID-19 naive, meaning they did not have a COVID-19 outbreak (defined as more than 1 cases among residents and staff in the 10 weeks prior to mandate announcement). N=63822 facility weeks.

Figure B5: Effect of Mandate Announcement on Staffing Levels - Excluding Mandates announced between August 18, 2021 and September 9, 2021

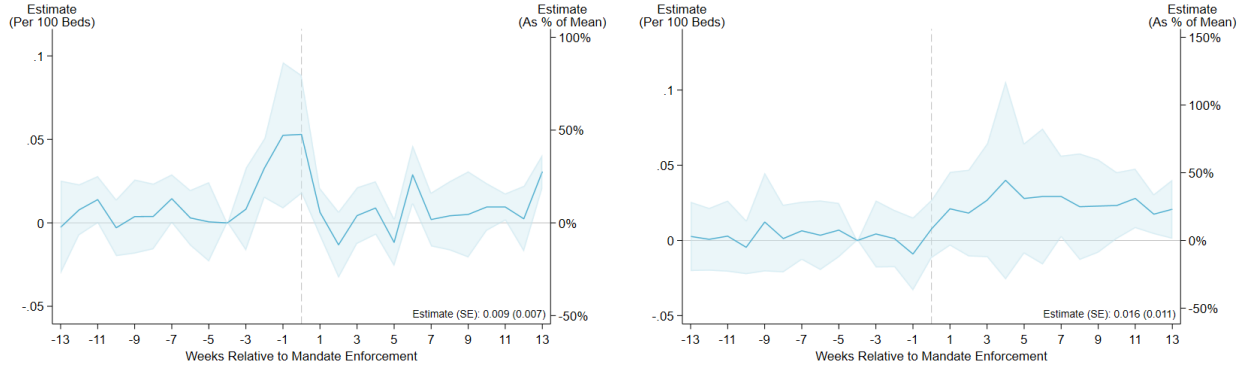
(a) Staff Size **(b) Hours Per Patient Day**



Notes. These figures plot stacked event study regression estimates comparing treated nursing homes that implemented a vaccination mandate relative to control nursing homes that did not implement a vaccination mandate. Regressions include nursing home and week fixed effects. Standard errors are clustered at the chain level. Estimates are computed relative to a baseline one week prior to mandate announcement. The left axes present the estimates, and the right axes present the estimates scaled by the mean of the outcome variable for treated nursing homes in the baseline week. The pooled estimate in the lower-right corner provides the difference between the post- and pre-treatment average coefficients.

Figure B6: Effect of Mandate Enforcement on CNA Separations and Hiring - Excluding Mandates announced between August 18, 2021 and September 9, 2021

(a) Separations **(b) Hires**

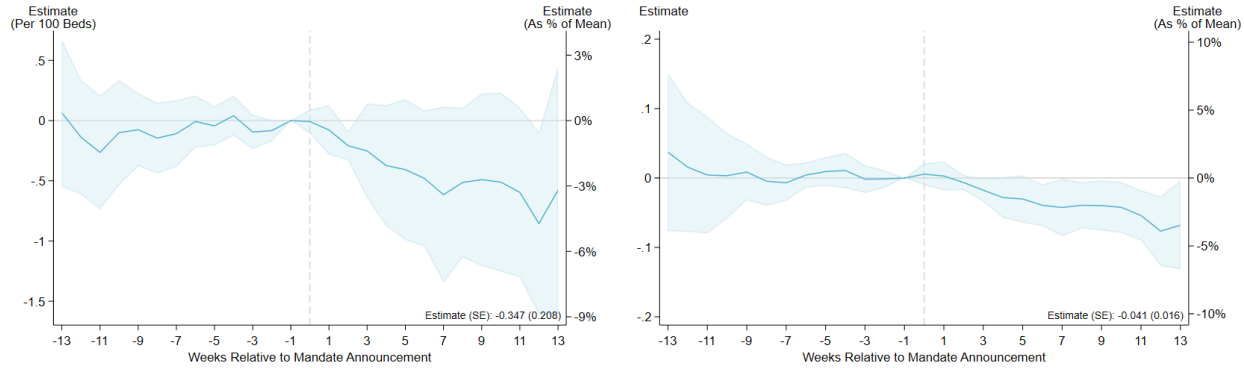


Notes. These figures plot stacked event study regression estimates comparing treated nursing homes that implemented a vaccination mandate relative to control nursing homes that did not implement a vaccination mandate. These results exclude facility-weeks beginning on October 31, 2021 as a federal vaccination mandate was published during that week on November 4, 2021. Regressions include nursing home and week fixed effects. Standard errors are clustered at the chain level. Estimates are computed relative to a baseline week that is 4 weeks prior to the mandate becoming enforced. Four weeks was the authorized interval between first and second dose for the Moderna vaccine. The left axes present the estimates, and the right axes present the estimates scaled by the mean of the outcome variable for treated nursing homes in the baseline week. The pooled estimate in the lower-right corner provides the difference between the post- and pre-treatment average coefficients.

B.2.2 Exclude Facility-Weeks After October 31, 2021

Figure B7: Effect of Mandate Announcement on CNA Staffing Levels - Excluding Facility-Weeks Beginning October 31, 2021

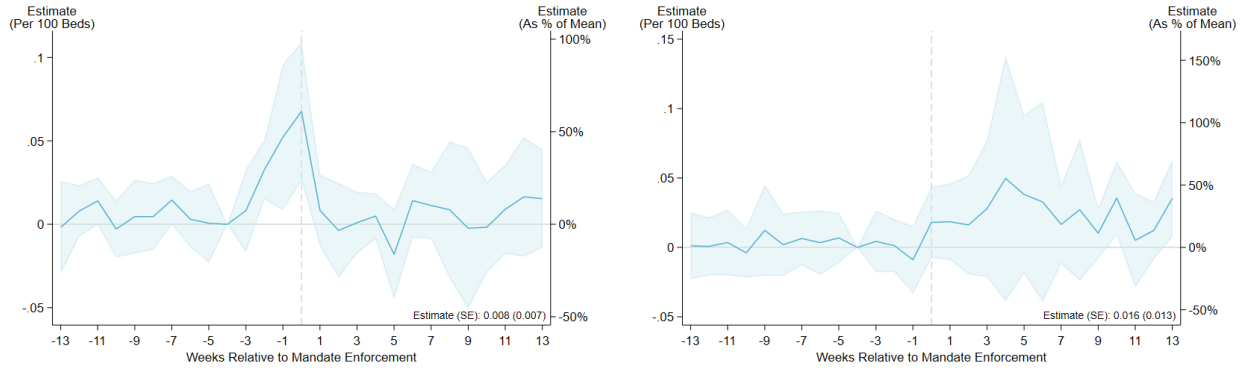
(a) Staff Size **(b) Hours Per Patient Day**



Notes. These figures plot stacked event study regression estimates comparing treated nursing homes that implemented a vaccination mandate relative to control nursing homes that did not implement a vaccination mandate. These results exclude facility-weeks beginning on October 31, 2021 as a federal vaccination mandate was published during that week on November 4, 2021. Regressions include nursing home and week fixed effects. Standard errors are clustered at the chain level. Estimates are computed relative to a baseline one week prior to mandate announcement. The left axes present the estimates, and the right axes present the estimates scaled by the mean of the outcome variable for treated nursing homes in the baseline week. The pooled estimate in the lower-right corner provides the difference between the post- and pre-treatment average coefficients.

Figure B8: Effect of Mandate Enforcement on CNA Separations and Hiring - Excluding Facility-Weeks Beginning October 31, 2021

(a) Separations **(b) Hires**

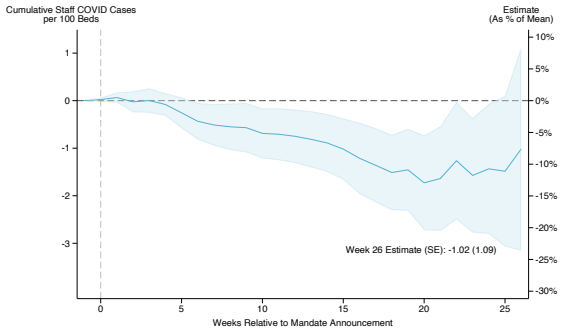


Notes. These figures plot stacked event study regression estimates comparing treated nursing homes that implemented a vaccination mandate relative to control nursing homes that did not implement a vaccination mandate. Regressions include nursing home and week fixed effects. Standard errors are clustered at the chain level. Estimates are computed relative to a baseline week that is 4 weeks prior to the mandate becoming enforced. Four weeks was the authorized interval between first and second dose for the Moderna vaccine. The left axes present the estimates, and the right axes present the estimates scaled by the mean of the outcome variable for treated nursing homes in the baseline week. The pooled estimate in the lower-right corner provides the difference between the post- and pre-treatment average coefficients.

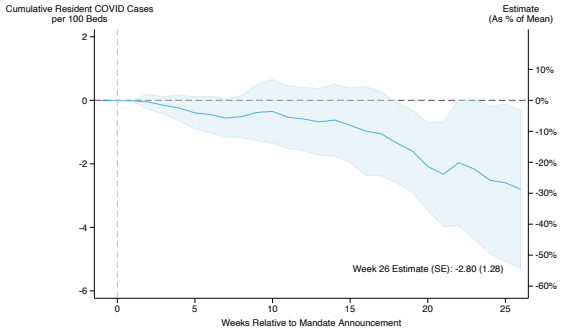
B.2.3 Include Facility-Weeks After January 2, 2022

Figure B9: Effect of Mandate Announcement on COVID-19 Cases and Deaths - Including Facility-Weeks After January 4, 2022

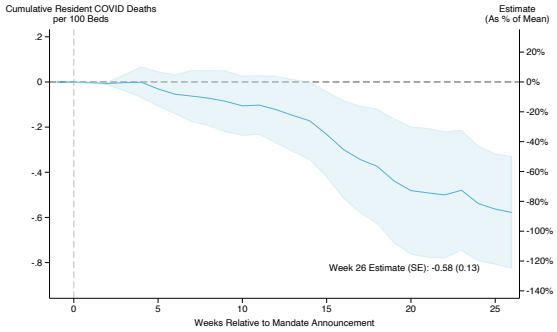
(a) Staff Cases



(b) Resident Cases



(c) Resident Deaths

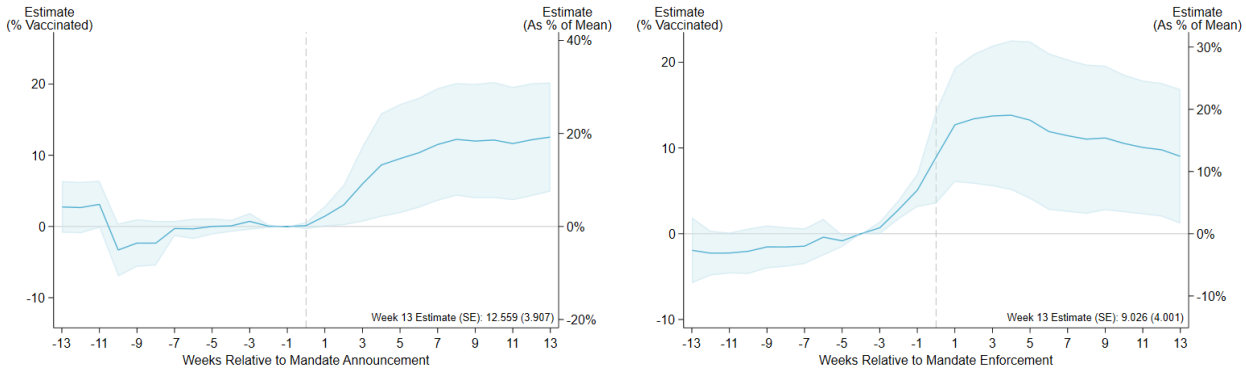


Notes. These figures plot cumulative event study regression estimates comparing treated nursing homes that implemented a vaccination mandate relative to nursing homes that did not implement a vaccination mandate. Analyses are restricted to the subgroup of nursing homes that were Covid-19 naive, meaning they did not have a Covid-19 outbreak (defined as more than 1 cases among residents and staff in the 10 weeks prior to mandate announcement). These results include facility-weeks that occurred after January 4, 2022 when the federal mandate was enacted for states that did not join the federal lawsuit against the mandates. N=67408 facility weeks.

B.2.4 Modeling State and Federal Mandates

Figure B10: Effect of Mandates on Staff Vaccination Rates - Modeling State and Federal Mandate Facility-Weeks

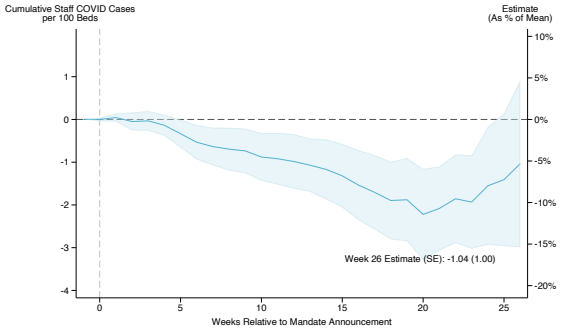
(a) Mandate Announcement **(b) Mandate Enforcement**



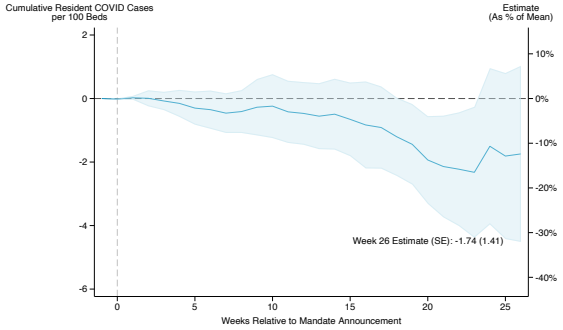
Notes. These figures plot stacked event study regression estimates comparing treated nursing homes that implemented a vaccination mandate relative to control nursing homes that did not implement a vaccination mandate. These results do not exclude facility-weeks that were affected by a state or federal mandate. Instead, We included interactions between our event-time indicators and indicators for a state mandate being effect and a federal mandate being in effect (using January 4, 2022 when the mandate applied to 26 states). Models continue include nursing home and week fixed effects. Standard errors are clustered at the chain level. Estimates in (a) are computed relative to a baseline one week prior to mandate announcement. Estimates in (b) are computed relative to a baseline week that is four weeks prior to the mandate becoming enforced. Four weeks was the authorized interval between first and second dose for the Moderna vaccine. The left axes present the estimates, and the right axes present the estimates scaled by the mean of the outcome variable for treated nursing homes in the baseline week. The estimate in the lower-right corner is the effect of the mandate 13 weeks post mandate announcement and enforcement.

Figure B11: Effect of Mandate Announcement on COVID-19 Cases and Deaths - Modeling State and Federal Mandate Facility-Weeks

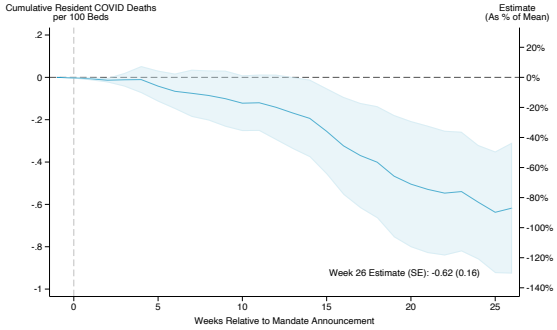
(a) Staff Cases



(b) Resident Cases



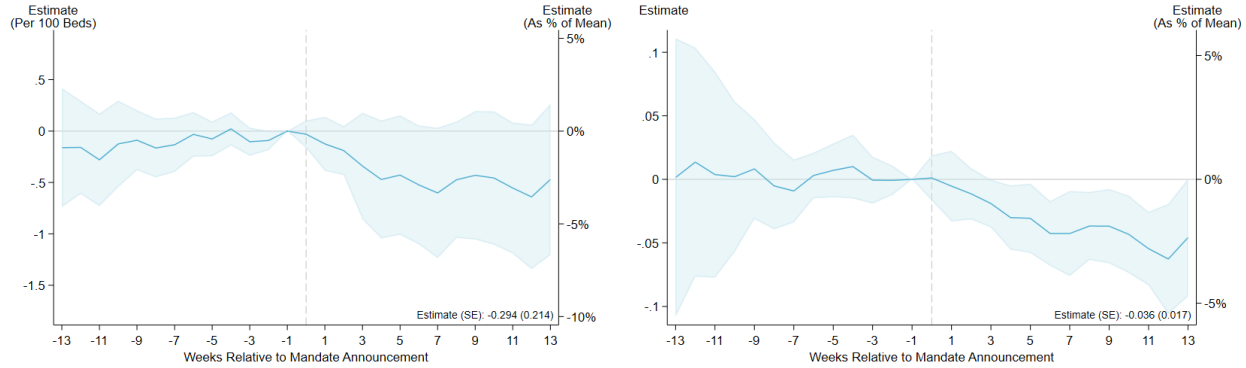
(c) Resident Deaths



Notes. These figures plot cumulative event study regression estimates comparing treated nursing homes that implemented a vaccination mandate relative to nursing homes that did not implement a vaccination mandate. Analyses are restricted to the subgroup of nursing homes that were Covid-19 naive, meaning they did not have a Covid-19 outbreak (defined as more than 1 cases among residents and staff in the 10 weeks prior to mandate announcement). These results do not exclude facility-weeks that were affected by a state or federal mandate. Instead, We included interactions between our event-time indicators and indicators for a state mandate being effect and a federal mandate being in effect (using January 4, 2022 when the mandate applied to 26 states). Models continue to include county-by-week fixed effects and controls for resident vaccination rates. The figures plot the estimates from the event-time estimates that were not affected by state or federal mandates. N=139764 facility weeks.

Figure B12: Effect of Mandate Announcement on Staffing Levels - Modeling State and Federal Mandates Facility-Weeks

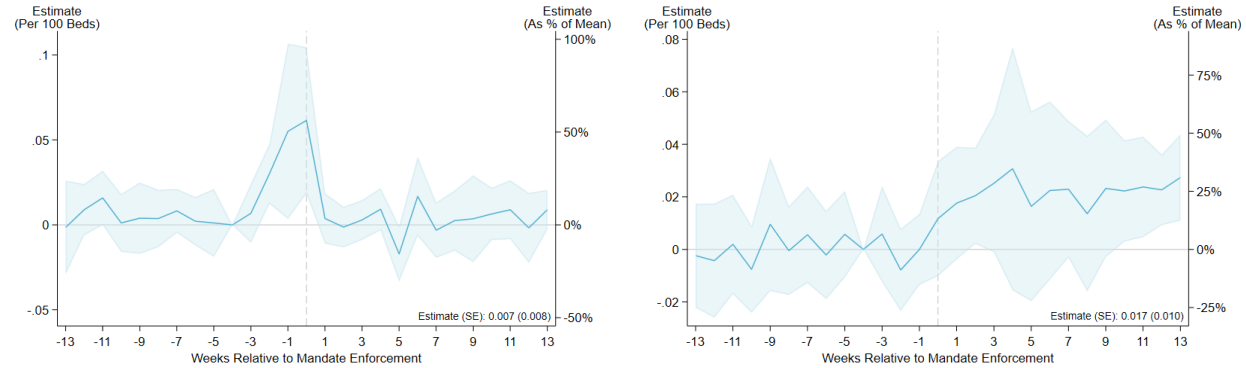
(a) Staff Size **(b) Hours Per Patient Day**



Notes. These figures plot stacked event study regression estimates comparing treated nursing homes that implemented a vaccination mandate relative to control nursing homes that did not implement a vaccination mandate. These results do not exclude facility-weeks that were affected by a state or federal mandate. Instead, We included interactions between our event-time indicators and indicators for a state mandate being effect and a federal mandate being in effect (using January 4, 2022 when the mandate applied to 26 states). Models continue to include nursing home and week fixed effects. Standard errors are clustered at the chain level. Estimates are computed relative to a baseline one week prior to mandate announcement. The left axes present the estimates, and the right axes present the estimates scaled by the mean of the outcome variable for treated nursing homes in the baseline week. The pooled estimate in the lower-right corner provides the difference between the post- and pre-treatment average coefficients.

Figure B13: Effect of Mandate Enforcement on CNA Separations and Hiring - Modeling State and Federal Mandates Facility-Weeks

(a) Separations **(b) Hires**



Notes. These figures plot stacked event study regression estimates comparing treated nursing homes that implemented a vaccination mandate relative to control nursing homes that did not implement a vaccination mandate. These results do not exclude facility-weeks that were affected by a state or federal mandate. Instead, We included interactions between our event-time indicators and indicators for a state mandate being effect and a federal mandate being in effect (using January 4, 2022 when the mandate applied to 26 states). Models continue to include nursing home and week fixed effects. Standard errors are clustered at the chain level. Estimates are computed relative to a baseline week that is 4 weeks prior to the mandate becoming enforced. Four weeks was the authorized interval between first and second dose for the Moderna vaccine. The left axes present the estimates, and the right axes present the estimates scaled by the mean of the outcome variable for treated nursing homes in the baseline week. The pooled estimate in the lower-right corner provides the difference between the post- and pre-treatment average coefficients.

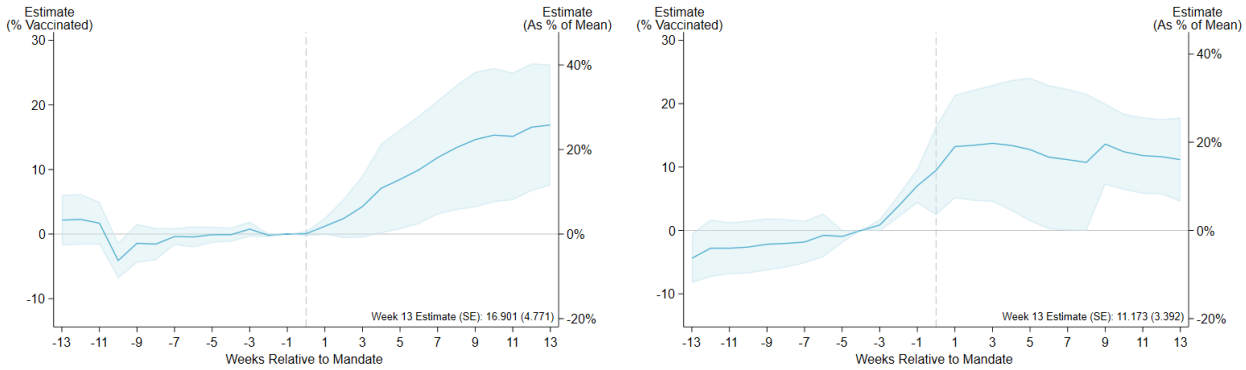
B.3 Excluding Control Facilities Near Treated Facilities

B.3.1 Excluding Control Facilities in the Same County

Figure B14: Effect of Mandates on Staff Vaccination Rates

Excluding control nursing homes in the same county as treated nursing homes

(a) Mandate Announcement **(b) Mandate Enforcement**



Notes. These figures plot stacked event study regression estimates comparing treated nursing homes that implemented a vaccination mandate relative to control nursing homes that did not implement a vaccination mandate. Regressions include nursing home and week fixed effects. Standard errors are clustered at the chain level. Estimates in (a) are computed relative to a baseline one week prior to mandate announcement. Estimates in (b) are computed relative to a baseline week that is four weeks prior to the mandate becoming enforced. Four weeks was the authorized interval between first and second dose for the Moderna vaccine. The left axes present the estimates, and the right axes present the estimates scaled by the mean of the outcome variable for treated nursing homes in the baseline week. The estimate in the lower-right corner is the effect of the mandate 13 weeks post mandate announcement and enforcement

Figure B15: Effect of Mandate Announcement on Staffing Levels

Excluding control nursing homes in the same county as treated nursing homes

(a) Staff Size **(b) Hours Per Patient Day**

Notes. These figures plot stacked event study regression estimates comparing treated nursing homes that implemented a vaccination mandate relative to control nursing homes that did not implement a vaccination mandate. Control facilities located in the same county as any treated facility are excluded from the analyses. Regressions include nursing home and week fixed effects. Standard errors are clustered at the chain level. Estimates are computed relative to a baseline one week prior to mandate announcement. The left axes present the estimates, and the right axes present the estimates scaled by the mean of the outcome variable for treated nursing homes in the baseline week. The pooled estimate in the lower-right corner provides the difference between the post- and pre-treatment average coefficients.

Figure B16: Effect of Mandate Enforcement on Staffing Changes

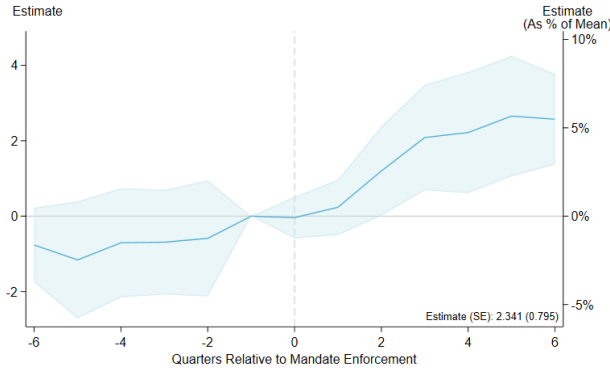
Excluding control nursing homes in the same county as treated nursing homes

(a) Separations **(b) Hires**

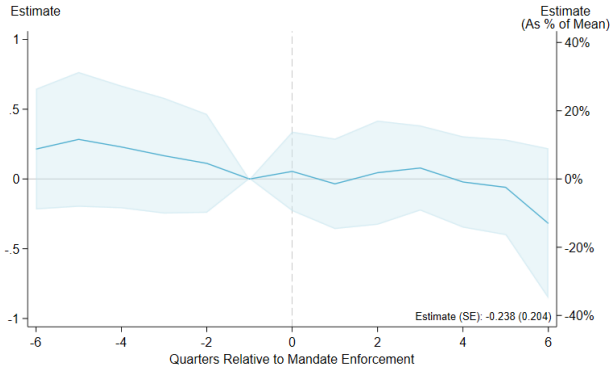
Notes. These figures plot stacked event study regression estimates comparing treated nursing homes that implemented a vaccination mandate relative to control nursing homes that did not implement a vaccination mandate. Control facilities located in the same county as any treated facility are excluded from the analyses. Regressions include nursing home and week fixed effects. Standard errors are clustered at the chain level. Estimates are computed relative to a baseline week that is 4 weeks prior to the mandate becoming enforced. Four weeks was the authorized interval between first and second dose for the Moderna vaccine. The left axes present the estimates, and the right axes present the estimates scaled by the mean of the outcome variable for treated nursing homes in the baseline week. The pooled estimate in the lower-right corner provides the difference between the post- and pre-treatment average coefficients.

Figure B17: Effect of Mandate Enforcement on Adverse Patient Events: excluding control nursing homes in the same county as treated nursing homes

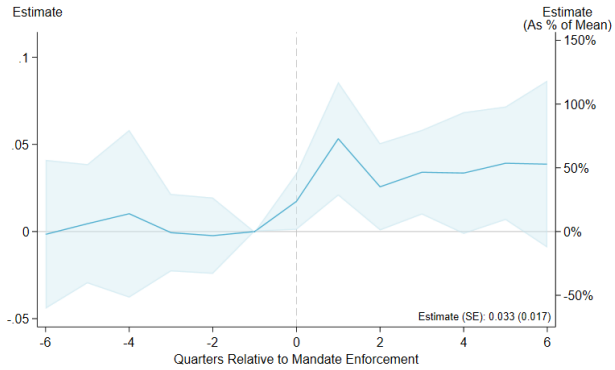
(a) Bladder Incontinence



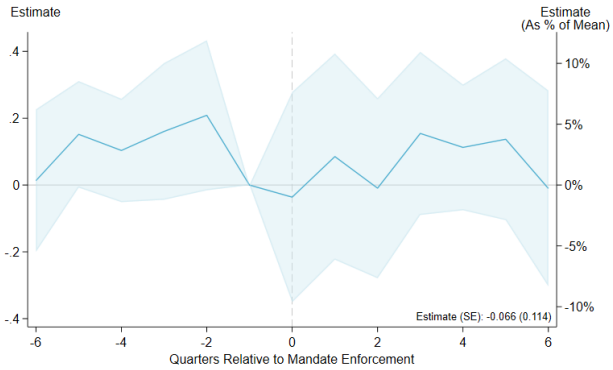
(b) Urinary Tract Infection



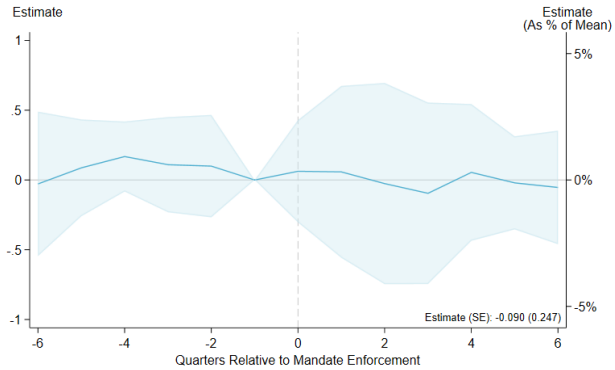
(c) Physically Restrained



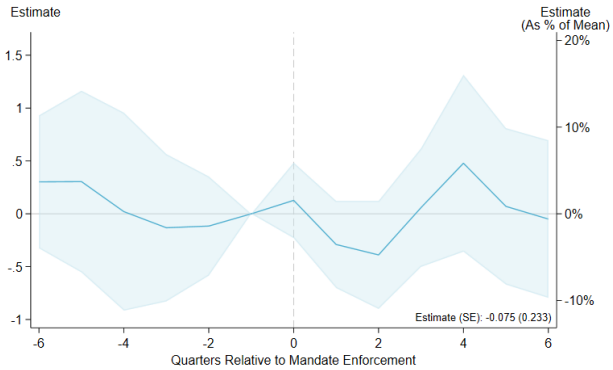
(d) 1+ Falls with Major Injury



(e) Anti-anxiety or Hypnotic Medication



(f) Pressure Ulcer

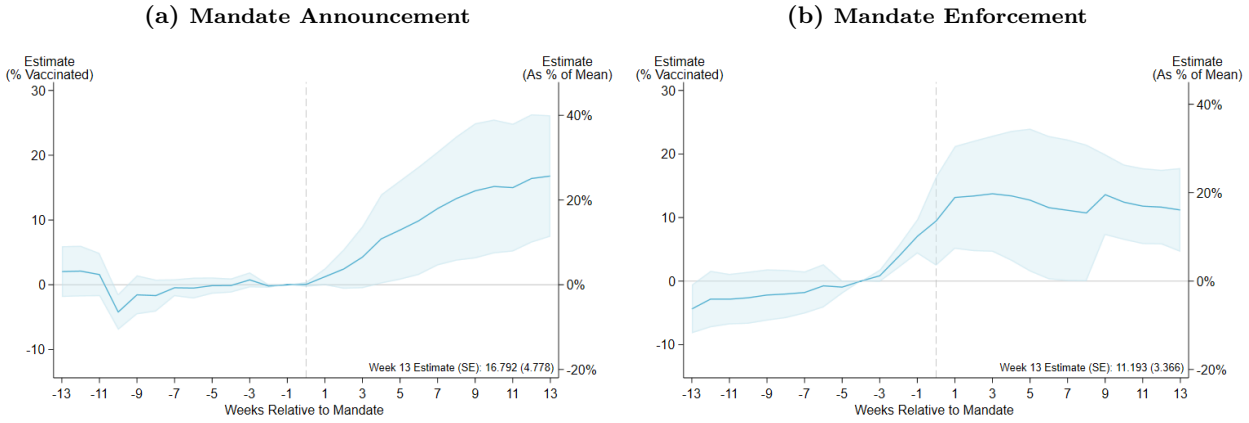


Notes. These figures plot stacked event study regression estimates comparing treated nursing homes that implemented a vaccination mandate relative to control nursing homes that did not implement a vaccination mandate. Control facilities located in the same county as any treated facility are excluded from the analyses. Regressions include nursing home and quarter fixed effects. Standard errors are clustered at the chain level. Estimates are computed relative to a baseline quarter that is one quarter prior to the mandate becoming enforced. The left axes present the estimates, and the right axes present the estimates scaled by the mean of the outcome variable for treated nursing homes in the baseline week. The pooled estimate in the lower-right corner provides the difference between the post- and pre-treatment average coefficients. All estimates are for nursing home long-stay residents.

B.3.2 Excluding Control Facilities Within 20 Miles

Figure B18: Effect of Mandates on Staff Vaccination Rates

Excluding control nursing homes within 20 miles of treated nursing homes

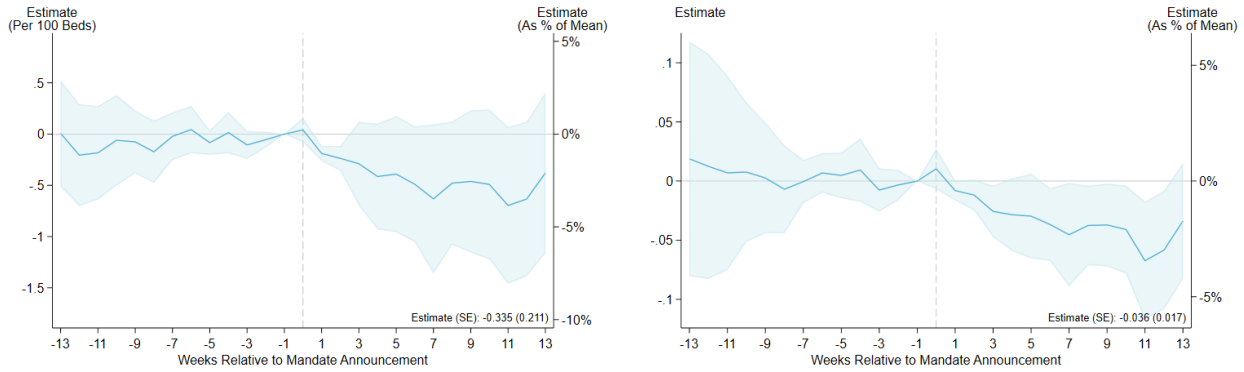


Notes. These figures plot stacked event study regression estimates comparing treated nursing homes that implemented a vaccination mandate relative to control nursing homes that did not implement a vaccination mandate. Regressions include nursing home and week fixed effects. Standard errors are clustered at the chain level. Estimates in (a) are computed relative to a baseline one week prior to mandate announcement. Estimates in (b) are computed relative to a baseline week that is four weeks prior to the mandate becoming enforced. Four weeks was the authorized interval between first and second dose for the Moderna vaccine. The left axes present the estimates, and the right axes present the estimates scaled by the mean of the outcome variable for treated nursing homes in the baseline week. The estimate in the lower-right corner is the effect of the mandate 13 weeks post mandate announcement and enforcement.

Figure B19: Effect of Mandate Announcement on Staffing Levels

Excluding control nursing homes within 20 miles of treated nursing homes

(a) Staff Size **(b) Hours Per Patient Day**

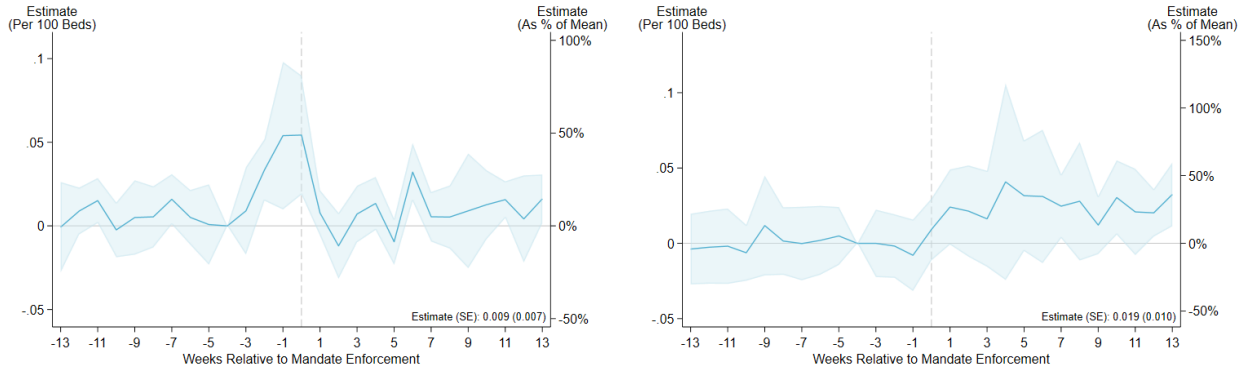


Notes. These figures plot stacked event study regression estimates comparing treated nursing homes that implemented a vaccination mandate relative to control nursing homes that did not implement a vaccination mandate. Control facilities located within 20 miles of any treated facility are excluded. Regressions include nursing home and week fixed effects. Standard errors are clustered at the chain level. Estimates are computed relative to a baseline one week prior to mandate announcement. The left axes present the estimates, and the right axes present the estimates scaled by the mean of the outcome variable for treated nursing homes in the baseline week. The pooled estimate in the lower-right corner provides the difference between the post- and pre-treatment average coefficients.

Figure B20: Effect of Mandate Enforcement on Staffing Changes

Excluding control nursing homes within 20 miles of treated nursing homes

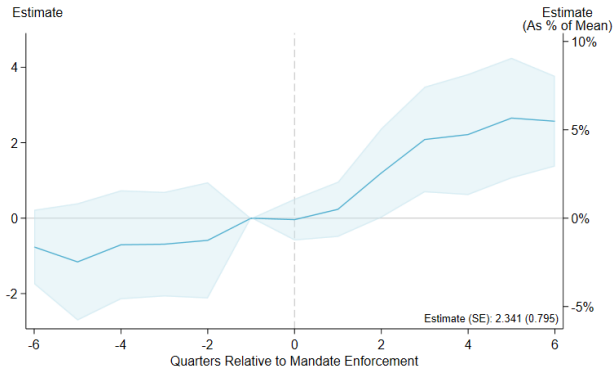
(a) Separations **(b) Hires**



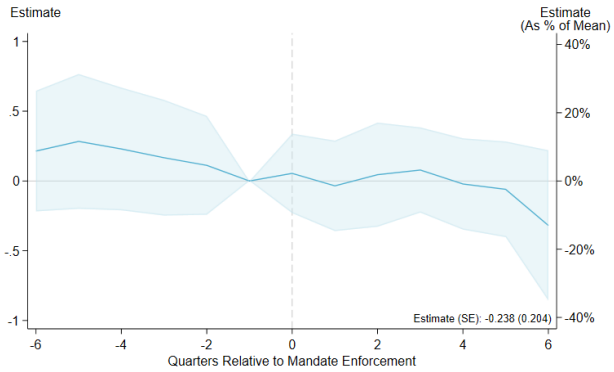
Notes. These figures plot stacked event study regression estimates comparing treated nursing homes that implemented a vaccination mandate relative to control nursing homes that did not implement a vaccination mandate. Control facilities located within 20 miles of any treated facility are excluded. Regressions include nursing home and week fixed effects. Standard errors are clustered at the chain level. Estimates are computed relative to a baseline week that is 4 weeks prior to the mandate becoming enforced. Four weeks was the authorized interval between first and second dose for the Moderna vaccine. The left axes present the estimates, and the right axes present the estimates scaled by the mean of the outcome variable for treated nursing homes in the baseline week. The pooled estimate in the lower-right corner provides the difference between the post- and pre-treatment average coefficients.

Figure B21: Effect of Mandate Enforcement on Adverse Patient Events: excluding control nursing homes within 20 miles of treated nursing homes

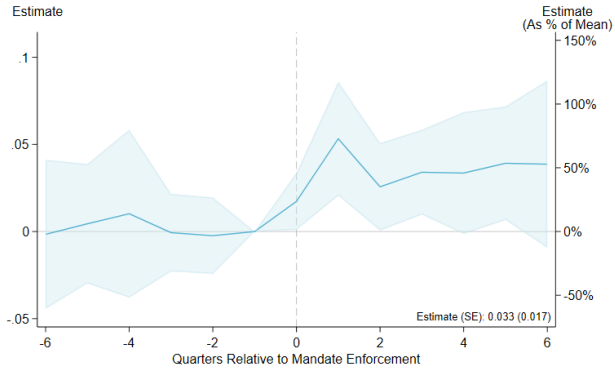
(a) Bladder Incontinence



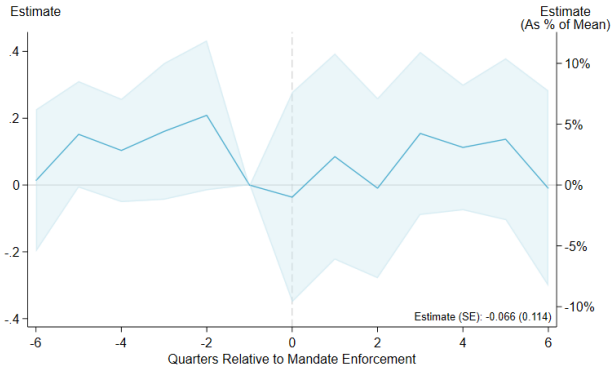
(b) Urinary Tract Infection



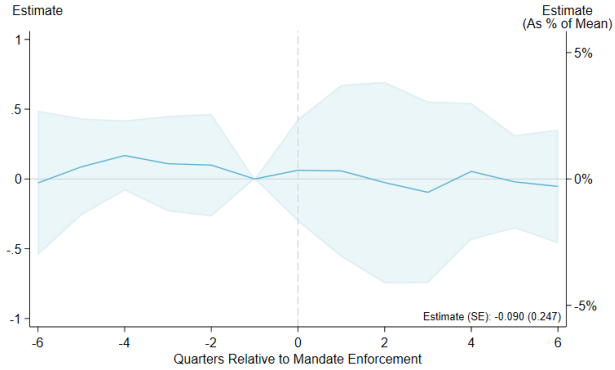
(c) Physically Restrained



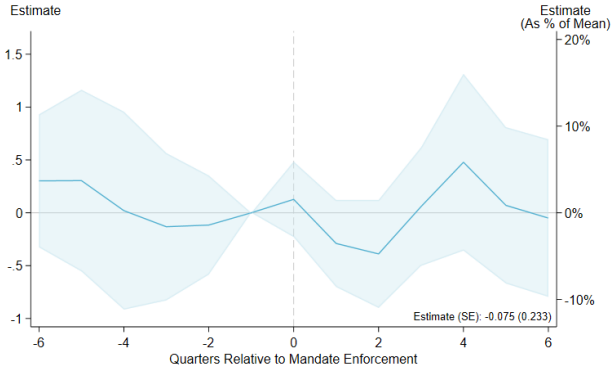
(d) 1+ Falls with Major Injury



(e) Anti-anxiety or Hypnotic Medication



(f) Pressure Ulcer

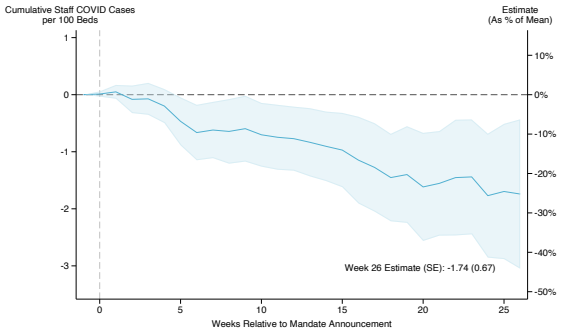


Notes. These figures plot stacked event study regression estimates comparing treated nursing homes that implemented a vaccination mandate relative to control nursing homes that did not implement a vaccination mandate. Control facilities located within 20 miles of any treated facility are excluded from the analyses. Regressions include nursing home and week fixed effects. Standard errors are clustered at the chain level. Estimates are computed relative to a baseline quarter that is one quarter prior to the mandate becoming enforced. The left axes present the estimates, and the right axes present the estimates scaled by the mean of the outcome variable for treated nursing homes in the baseline week. The pooled estimate in the lower-right corner provides the difference between the post- and pre-treatment average coefficients. All estimates are for nursing home long-stay residents.

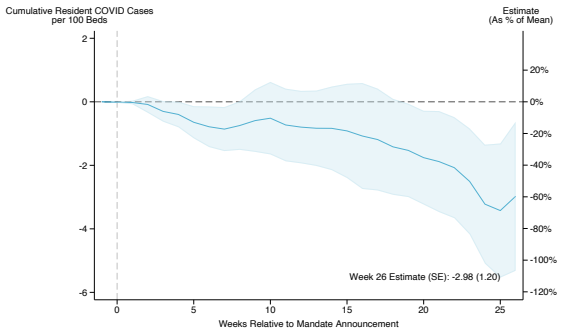
B.3.3 Excluding Closest Control Facilities

Figure B22: Effect of Mandate Announcement on COVID-19 Cases and Deaths - Drop Nearest

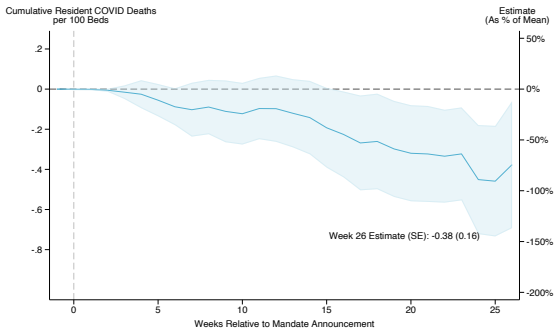
(a) Staff Cases



(b) Resident Cases



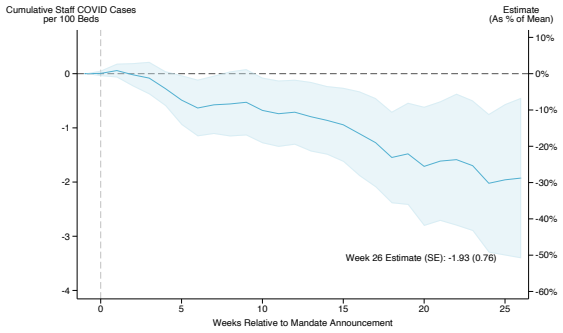
(c) Resident Deaths



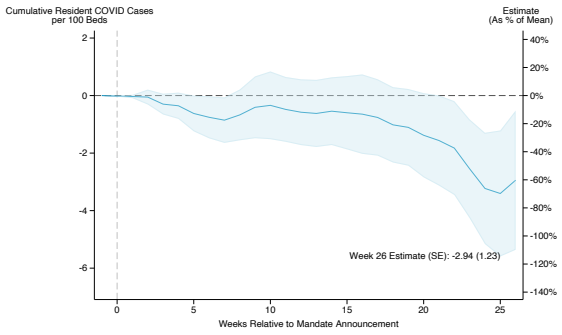
Notes. These figures plot cumulative stacked event study regression estimates obtained from the subgroup of nursing homes that did not have a Covid-19 outbreak (i.e., 1 or fewer total Covid-19 cases among residents and staff) in the 10 weeks prior to mandate announcement. Treated facilities are those that implemented a chain-level mandate and control facilities are those that did not. These analyses additionally exclude for each treated facilities the nearest (measured by linear distance) neighboring nursing homes to address potential network effects. Details on the stacking are provided in the Appendix. Regressions include controls for resident Covid-19 vaccination rates and nursing home and county-by-week fixed effects. Standard errors are clustered at the chain level. Estimates are computed relative to a baseline one week prior to mandate announcement. The left axes present the estimates, and the right axes present the estimates scaled by the mean of the outcome variable for study sample in the last week of follow-up.

Figure B23: Effect of Mandate Announcement on COVID-19 Cases and Deaths - Drop 2 Nearest

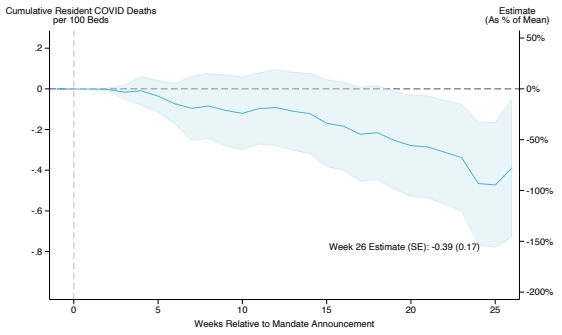
(a) Staff Cases



(b) Resident Cases



(c) Resident Deaths

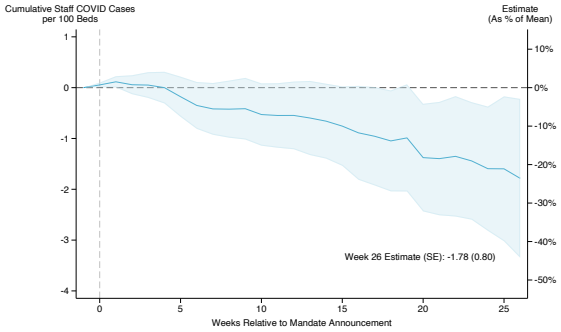


Notes. These figures plot cumulative stacked event study regression estimates obtained from the subgroup of nursing homes that did not have a Covid-19 outbreak (i.e., 1 or fewer total Covid-19 cases among residents and staff) in the 10 weeks prior to mandate announcement. Treated facilities are those that implemented a chain-level mandate and control facilities are those that did not. These analyses additionally exclude for each treated facilities the 2 nearest (measured by linear distance) neighboring nursing homes to address potential network effects. Details on the stacking are provided in the Appendix. Regressions include controls for resident Covid-19 vaccination rates and nursing home and county-by-week fixed effects. Standard errors are clustered at the chain level. Estimates are computed relative to a baseline one week prior to mandate announcement. The left axes present the estimates, and the right axes present the estimates scaled by the mean of the outcome variable for study sample in the last week of follow-up.

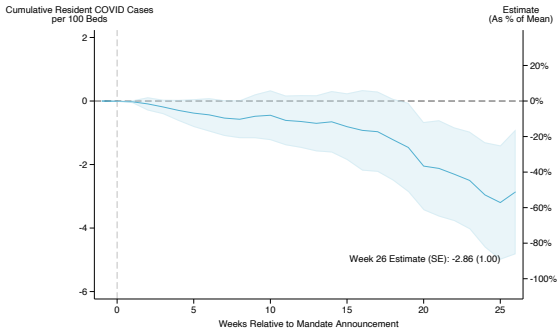
B.4 Alternative Definitions of Recent Outbreaks

Figure B24: Effect of Mandate Announcement on COVID-19 Cases and Deaths - Restrict to <=2 Pre-period Case

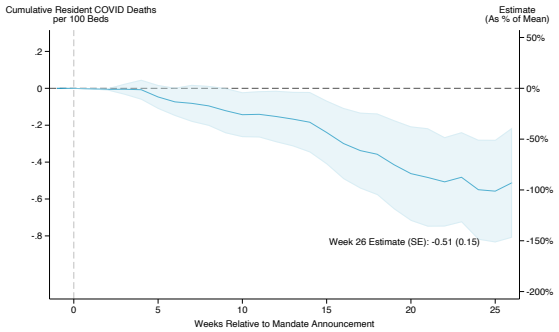
(a) Staff Cases



(b) Resident Cases



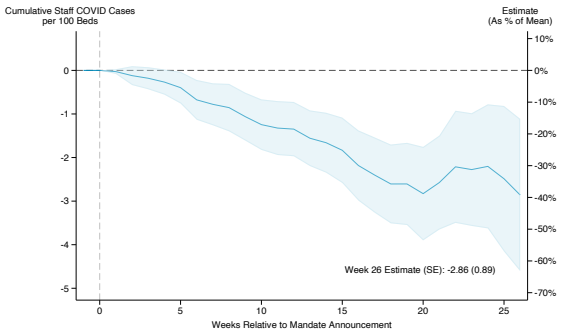
(c) Resident Deaths



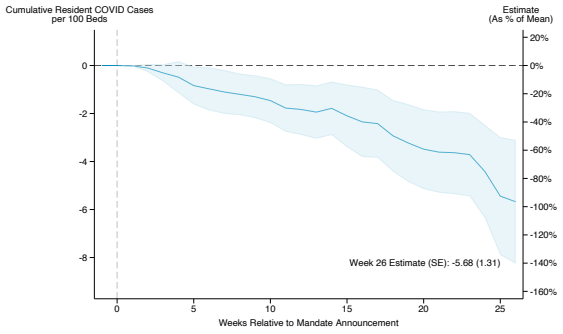
Notes. These figures plot cumulative stacked event study regression estimates obtained from the subgroup of nursing homes that had 2 or fewer total Covid-19 cases among residents and staff in the 10 weeks prior to mandate announcement. Treated facilities are those that implemented a chain-level mandate and control facilities are those that did not. Details on the stacking are provided in the Appendix. Regressions include controls for resident Covid-19 vaccination rates and nursing home and county-by-week fixed effects. Standard errors are clustered at the chain level. Estimates are computed relative to a baseline one week prior to mandate announcement. The left axes present the estimates, and the right axes present the estimates scaled by the mean of the outcome variable for study sample in the last week of follow-up. N=77664 facility weeks.

Figure B25: Effect of Mandate Announcement on COVID-19 Cases and Deaths - Restrict to 0 Pre-period Cases

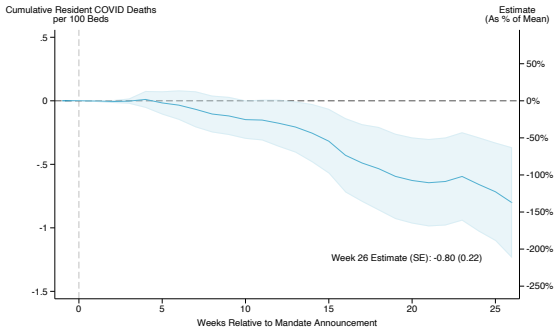
(a) Staff Cases



(b) Resident Cases



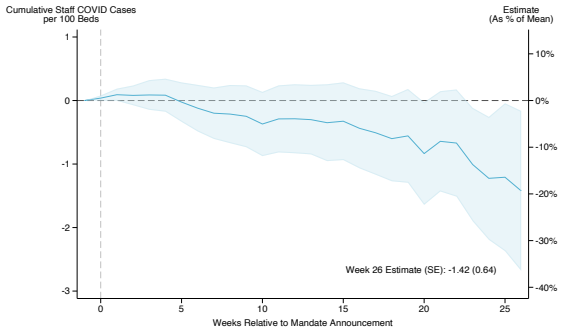
(c) Resident Deaths



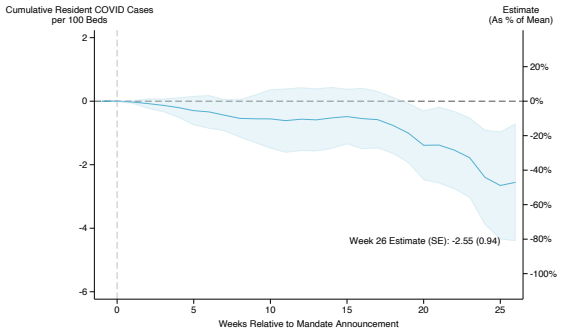
Notes. These figures plot cumulative stacked event study regression estimates obtained from the subgroup of nursing homes that had 0 total Covid-19 cases among residents and staff in the 10 weeks prior to mandate announcement. and were therefore fully Covid-naive. Treated facilities are those that implemented a chain-level mandate and control facilities are those that did not. Details on the stacking are provided in the Appendix. Regressions include controls for resident Covid-19 vaccination rates and nursing home and county-by-week fixed effects. Standard errors are clustered at the chain level. Estimates are computed relative to a baseline one week prior to mandate announcement. The left axes present the estimates, and the right axes present the estimates scaled by the mean of the outcome variable for study sample in the last week of follow-up. N=41234 facility weeks.

Figure B26: Effect of Mandate Announcement on COVID-19 Cases and Deaths - County Covid Rate Controls

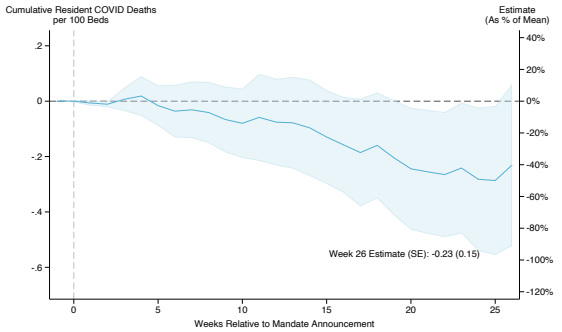
(a) Staff Cases



(b) Resident Cases



(c) Resident Deaths

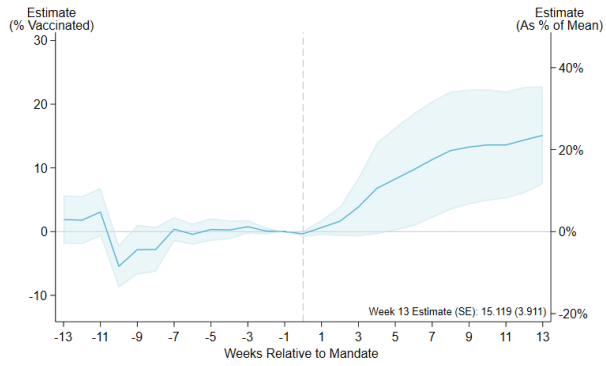


Notes. These figures plot cumulative stacked event study regression estimates obtained from the subgroup of nursing homes that did not have a Covid-19 outbreak (i.e., 1 or fewer total Covid-19 cases among residents and staff) in the 10 weeks prior to mandate announcement. Treated facilities are those that implemented a chain-level mandate and control facilities are those that did not. Details on the stacking are provided in the Appendix. Regressions include nursing home fixed effects, week fixed effects, controls for resident Covid-19 vaccination rates, and a control for the weekly rate of new Covid-19 cases in each county. Standard errors are clustered at the chain level. Estimates are computed relative to a baseline one week prior to mandate announcement. The left axes present the estimates, and the right axes present the estimates scaled by the mean of the outcome variable for study sample in the last week of follow-up. N=67269 facility weeks.

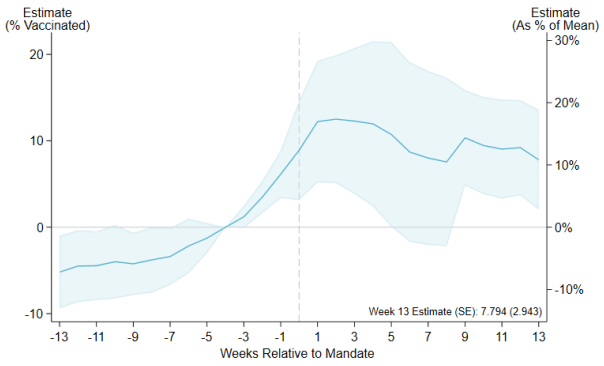
B.5 Restricting to the COVID-naive Sample

Figure B27: Effect of Mandate Announcement on Staff Vaccination Rates, Restricted to Sample of COVID-naive Facilities

(a) Mandate Announcement



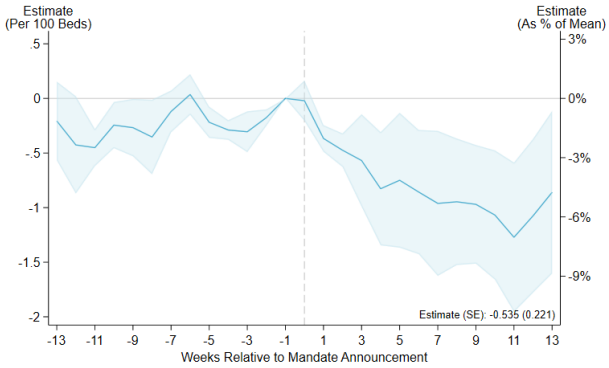
(b) Mandate Enforcement



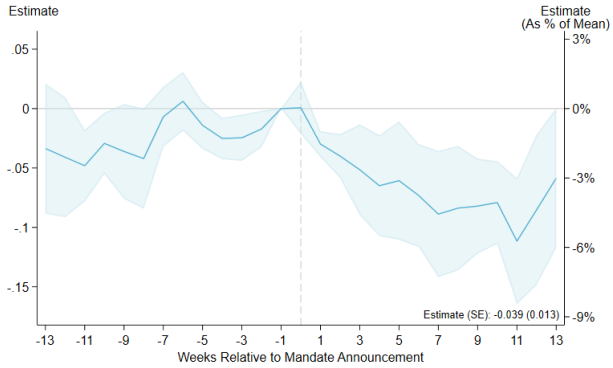
Notes. These figures plot stacked event study regression estimates comparing treated nursing homes that implemented a vaccination mandate relative to control nursing homes that did not implement a vaccination mandate. Regressions include nursing home and week fixed effects. Standard errors are clustered at the chain level. Estimates in (a) are computed relative to a baseline one week prior to mandate announcement. Estimates in (b) are computed relative to a baseline week that is four weeks prior to the mandate becoming enforced. Four weeks was the authorized interval between first and second dose for the Moderna vaccine. The left axes present the estimates, and the right axes present the estimates scaled by the mean of the outcome variable for treated nursing homes in the baseline week. The estimate in the lower-right corner is the effect of the mandate 13 weeks post mandate announcement and enforcement.

Figure B28: Effect of Mandate Announcement on Staffing Levels, Restricted to Sample of COVID-naive Facilities

(a) Staff Size



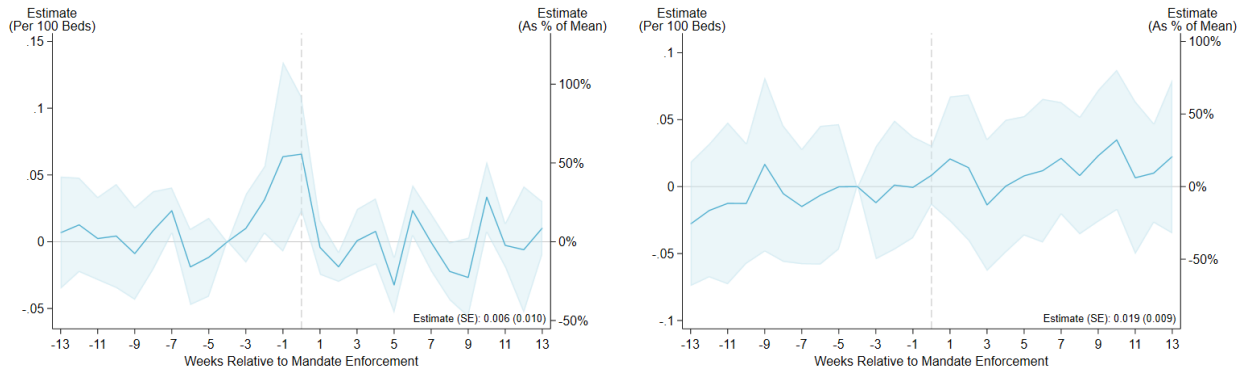
(b) Hour Per Patient Day



Notes. These figures plot stacked event study regressions which compare treated facilities that implemented a vaccination mandate relative to control facilities that did not implement a vaccination mandate. These analyses are restricted to chain operating nursing facilities. Regressions include week and facility fixed effects. Standard errors are clustered at the chain level. The y-axis on the left-hand side shows the change for each outcome relative to to the week when vaccination mandates were announced. The y-axis on the right-hand side represents the estimate as percent change relative to the week prior to the mandate announcement week. The x-axis illustrates the event-time relative to the week in which the chain's vaccination mandate was announced. The pooled estimate in the lower-right corner provides the difference between the post- and pre-treatment average coefficients.

Figure B29: Effect of Mandate Enforcement on Staff Separations, Restricted to Sample of COVID-naive Facilities

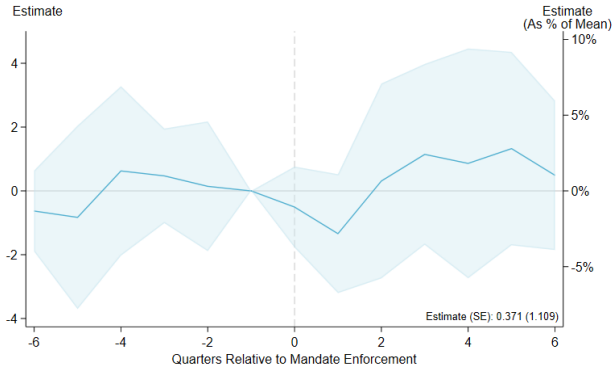
(a) Separations **(b) Hires**



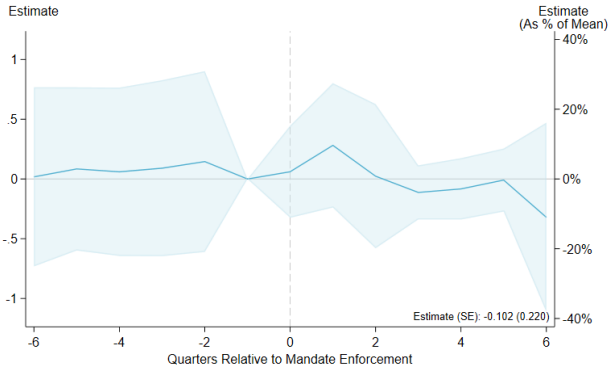
Notes. These figures plot stacked event study regression estimates comparing treated nursing homes that implemented a vaccination mandate relative to control nursing homes that did not implement a vaccination mandate. Regressions include nursing home and week fixed effects. Standard errors are clustered at the chain level. Estimates are computed relative to a baseline week that is 4 weeks prior to the mandate becoming enforced. Four weeks was the authorized interval between first and second dose for the Moderna vaccine. The left axes present the estimates, and the right axes present the estimates scaled by the mean of the outcome variable for treated nursing homes in the baseline week. The pooled estimate in the lower-right corner provides the difference between the post- and pre-treatment average coefficients.

Figure B30: Effect of Mandate Enforcement on Adverse Patient Events, Restricted to Sample of COVID-naive Facilities

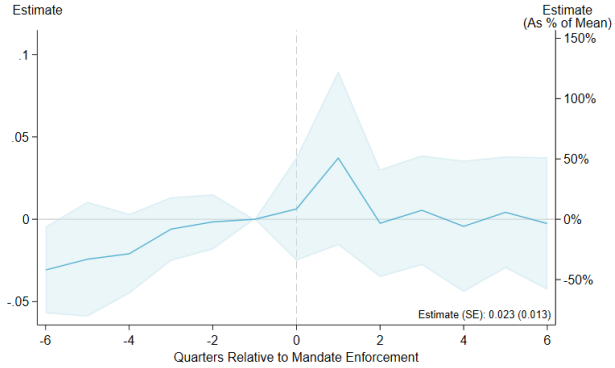
(a) Bladder Incontinence



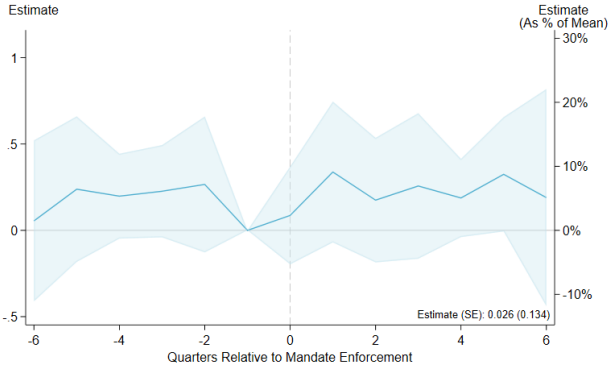
(b) Urinary Tract Infection



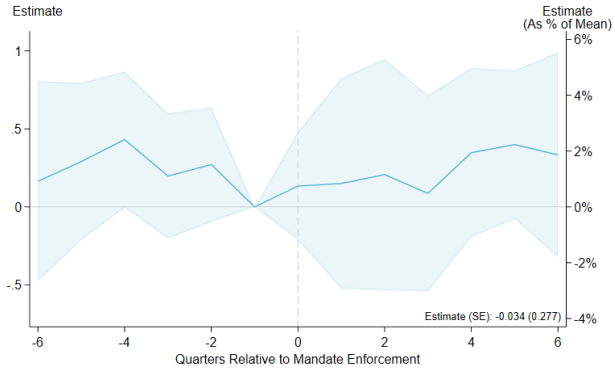
(c) Physically Restrained



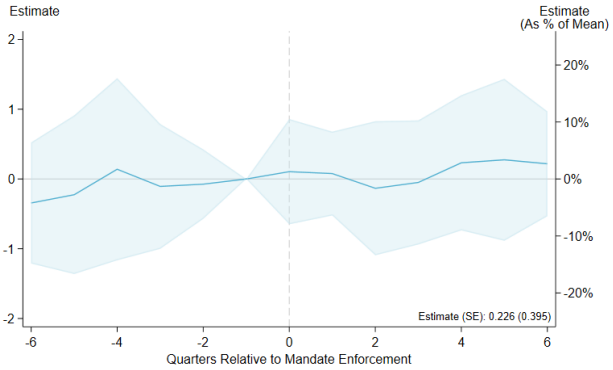
(d) 1+ Falls with Major Injury



(e) Anti-anxiety or Hypnotic Medication



(f) Pressure Ulcer

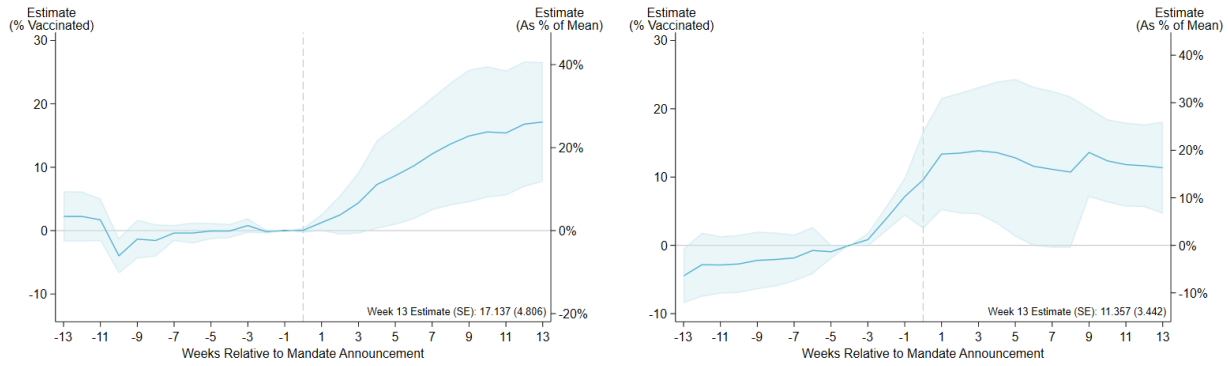


Notes. These figures plot stacked event study regression estimates comparing treated nursing homes that implemented a vaccination mandate relative to control nursing homes that did not implement a vaccination mandate. Control facilities located within 20 miles of any treated facility are excluded from the analyses. Regressions include nursing home and week fixed effects. Standard errors are clustered at the chain level. Estimates are computed relative to a baseline quarter that is one quarter prior to the mandate becoming enforced. The left axes present the estimates, and the right axes present the estimates scaled by the mean of the outcome variable for treated nursing homes in the baseline week. The pooled estimate in the lower-right corner provides the difference between the post- and pre-treatment average coefficients. All estimates are for nursing home long-stay residents.

B.6 Chain-Owned Control Facilities

Figure B31: Effect of Mandate Announcement on Staff Vaccination Rates Among Chain Facilities

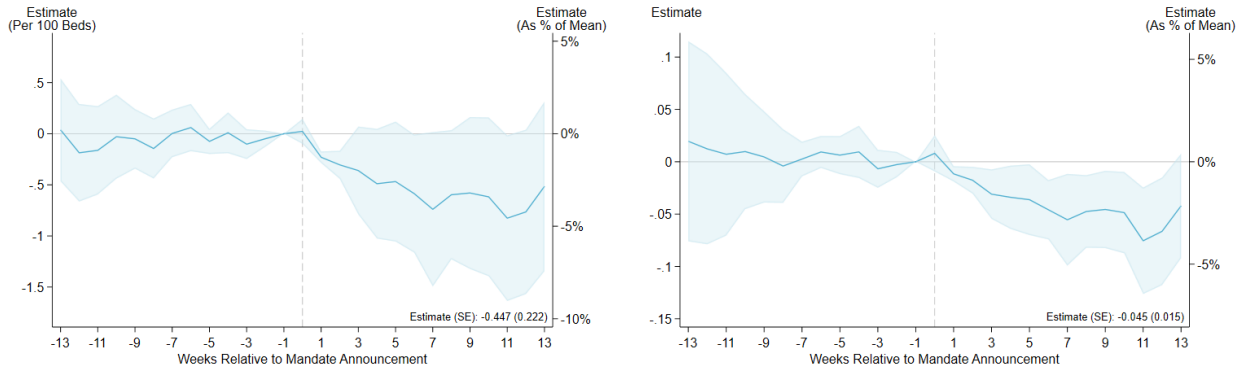
(a) Mandate Announcement **(b) Mandate Enforcement**



Notes. These figures plot stacked event study regression estimates comparing treated nursing homes that implemented a vaccination mandate relative to control nursing homes that did not implement a vaccination mandate. These analyses are restricted to chain operating nursing facilities. Regressions include nursing home and week fixed effects. Standard errors are clustered at the chain level. Estimates in (a) are computed relative to a baseline one week prior to mandate announcement. Estimates in (b) are computed relative to a baseline week that is four weeks prior to the mandate becoming enforced. Four weeks was the authorized interval between first and second dose for the Moderna vaccine. The left axes present the estimates, and the right axes present the estimates scaled by the mean of the outcome variable for treated nursing homes in the baseline week. The estimate in the lower-right corner is the effect of the mandate 13 weeks post mandate announcement and enforcement.

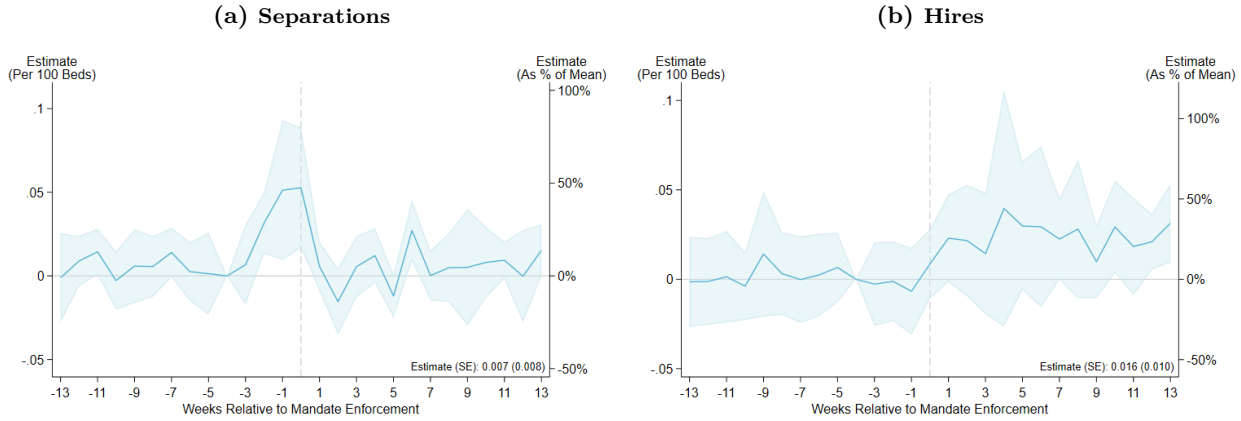
Figure B32: Effect of Mandate Announcement on CNA Staffing Levels Among Chain Facilities

(a) Staff Size **(b) Hour Per Patient Day**



Notes. These figures plot stacked event study regressions which compare treated facilities that implemented a vaccination mandate relative to control facilities that did not implement a vaccination mandate. These analyses are restricted to chain operating nursing facilities. Regressions include week and facility fixed effects. Standard errors are clustered at the chain level. The y-axis on the left-hand side shows the change for each outcome relative to to the week when vaccination mandates were announced. The y-axis on the right-hand side of panels (a) and (c) represents the estimate as percent change relative to the week prior to the mandate announcement week. The x-axis illustrates the event-time relative to the week in which the chain's vaccination mandate was announced.

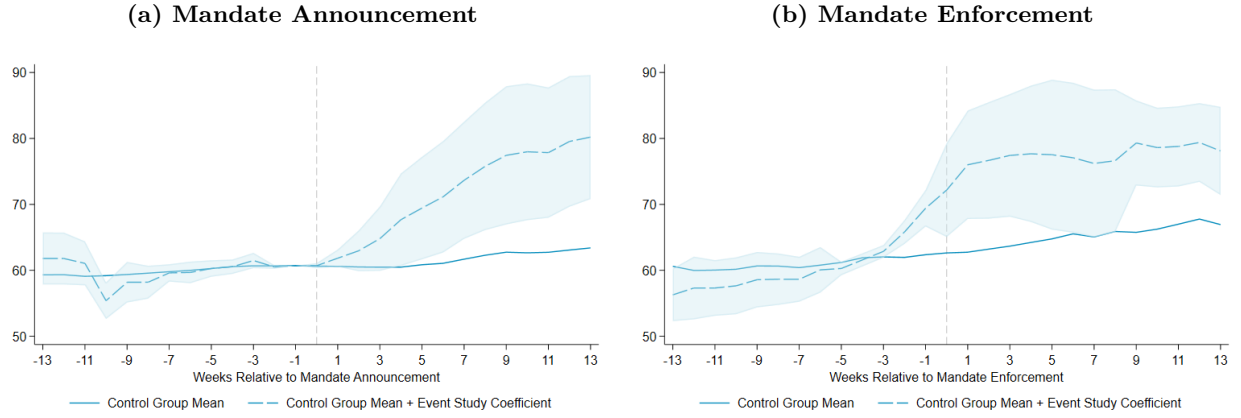
Figure B33: Effect of Mandate Enforcement on CNA Staffing Changes Among Chain Facilities



Notes. These figures plot stacked event study regressions which compare treated facilities that implemented a vaccination mandate relative to control facilities that did not implement a vaccination mandate. These analyses are restricted to chain operating nursing facilities. Regressions include week and facility fixed effects. Standard errors are clustered at the chain level. Estimates are computed relative to a baseline week that is 4 weeks prior to the mandate becoming enforced. Four weeks was the authorized interval between first and second dose for the Moderna vaccine. The y-axis on the left-hand side shows the change for each outcome relative to to the week when vaccination mandates were announced. The y-axis on the right-hand side of panels (a) and (c) represents the estimate as percent change relative to the week prior to the mandate announcement week. The x-axis illustrates the event-time relative to the week in which the chain's vaccination mandate was announced. The pooled estimate in the lower-right corner provides the difference between the post- and pre-treatment average coefficients.

B.7 Control Group Means

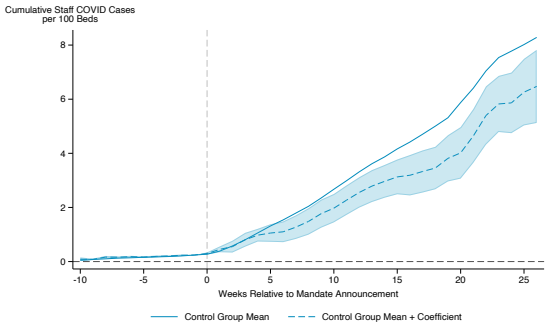
Figure B34: Effect of Mandates on Staff Vaccination Rates



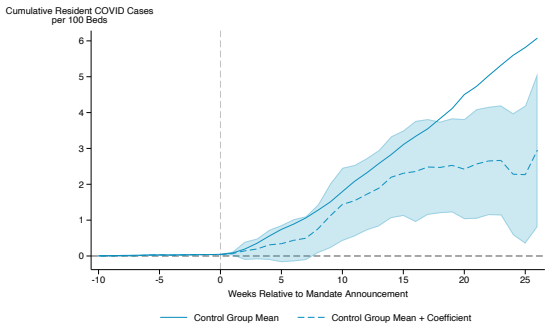
Notes. The solid line plots the mean of the control group over the event window. The dash line plots the mean of the control group plus the event study coefficients over the event window.

Figure B35: Effect of Mandate Announcement on COVID-19 Cases and Deaths

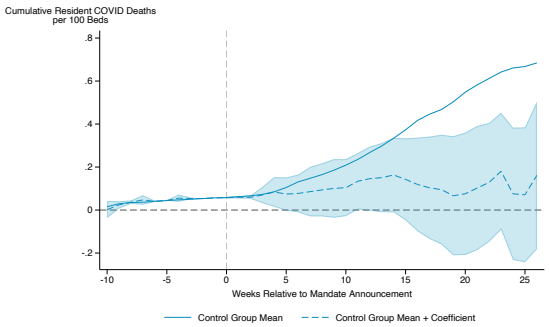
(a) Staff Cases



(b) Resident Cases

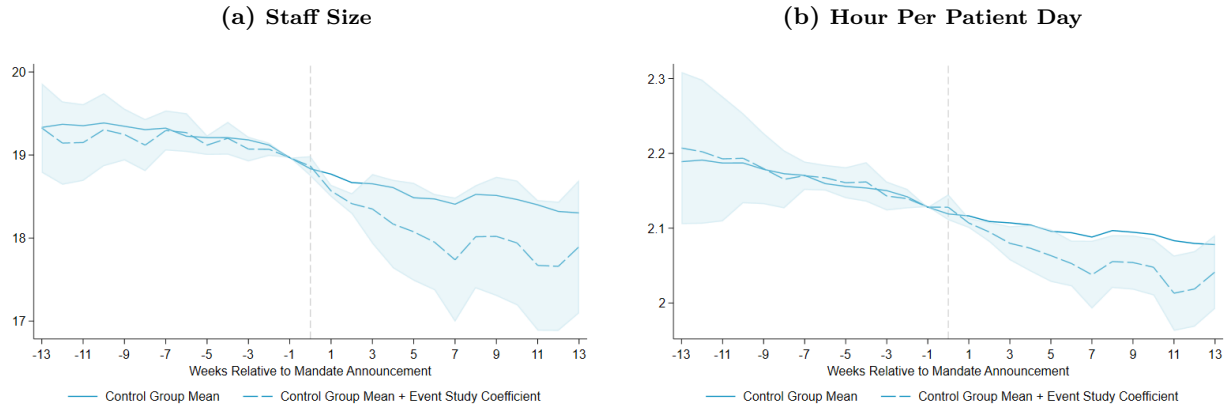


(c) Resident Deaths



Notes. The solid line plots the mean of the control group over the event window. The dash line plots the mean of the control group plus the event study coefficients over the event window. N=64208 facility weeks.

Figure B36: Effect of Mandate Announcement on Staffing Levels



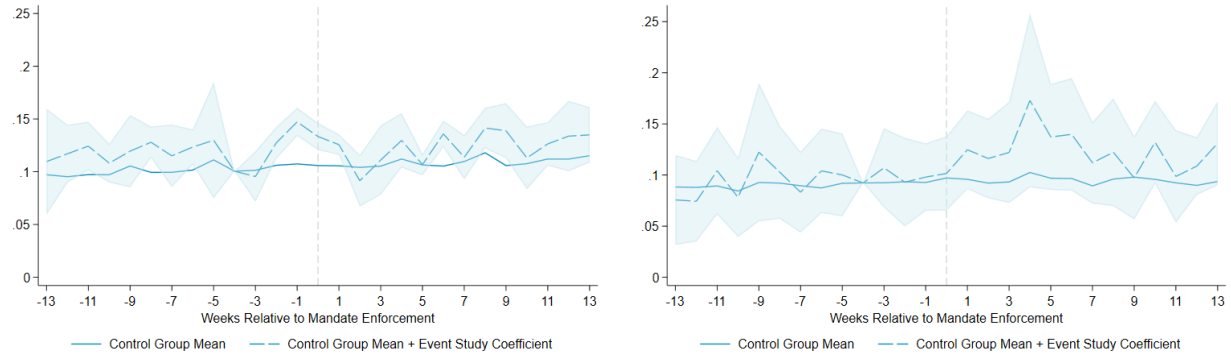
Notes. The solid line plots the mean of the control group over the event window. The dash line plots the mean of the control group plus the event study coefficients over the event window. There was a secular downward trend in staff size and hours per patient day over our study period.

Figure B37: Effect of Mandate Announcement on CNA Staffing Levels by Staff Type

Notes. The solid line plots the mean of the control group over the event window. The dash line plots the mean of the control group plus the event study coefficients over the event window. There was a secular downward trend in staff size and hours per patient day over our study period.

Figure B38: Effect of Mandate Enforcement on CNA Staffing Changes

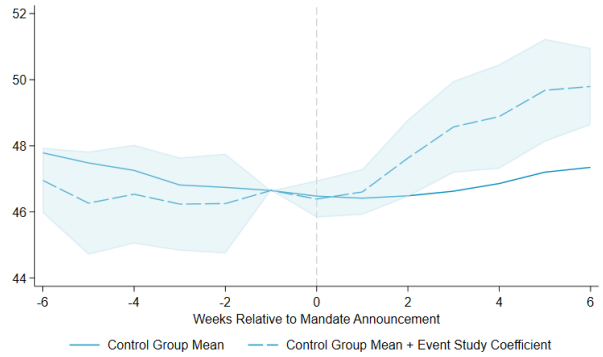
(a) Separations **(b) Hires**



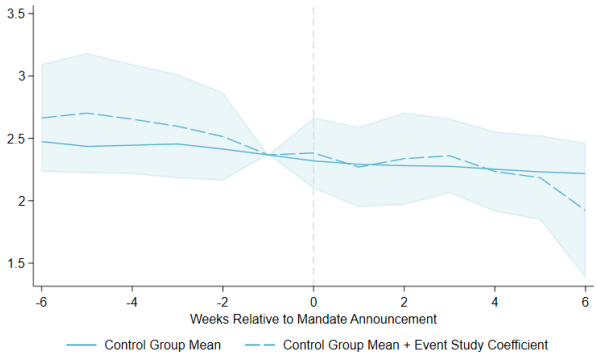
Notes. The solid line plots the mean of the control group over the event window. The dash line plots the mean of the control group plus the event study coefficients over the event window.

Figure B39: Effect of Mandate Enforcement on Adverse Patient Events

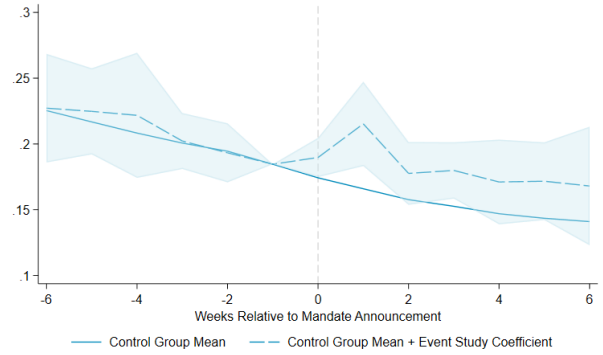
(a) Bladder Incontinence



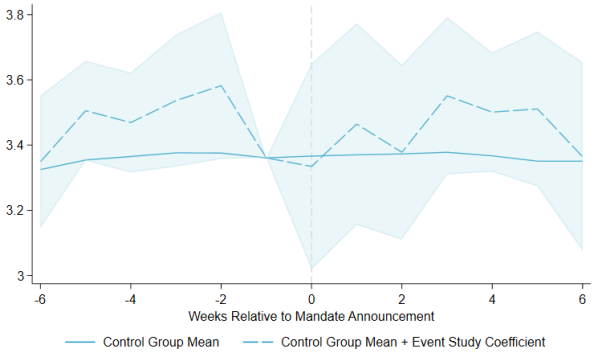
(b) Urinary Tract Infection



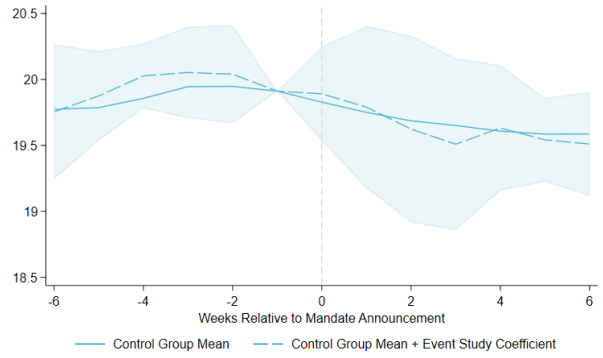
(c) Physically Restrained



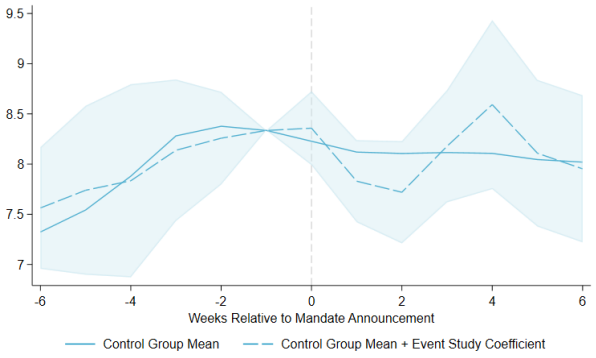
(d) 1+ Falls with Major Injury



(e) Anti-anxiety or Hypnotic Medication



(f) Pressure Ulcer

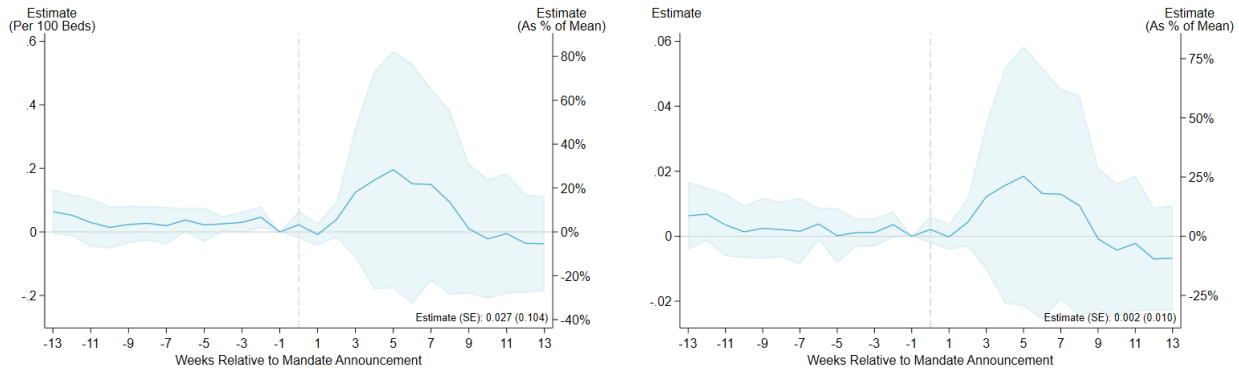


Notes. The solid line plots the mean of the control group over the event window. The dash line plots the mean of the control group plus the event study coefficients over the event window.

B.8 Estimates by Type of Staff

Figure B40: Effect of Mandate Announcement on CNA Staffing Levels Among Contract Workers

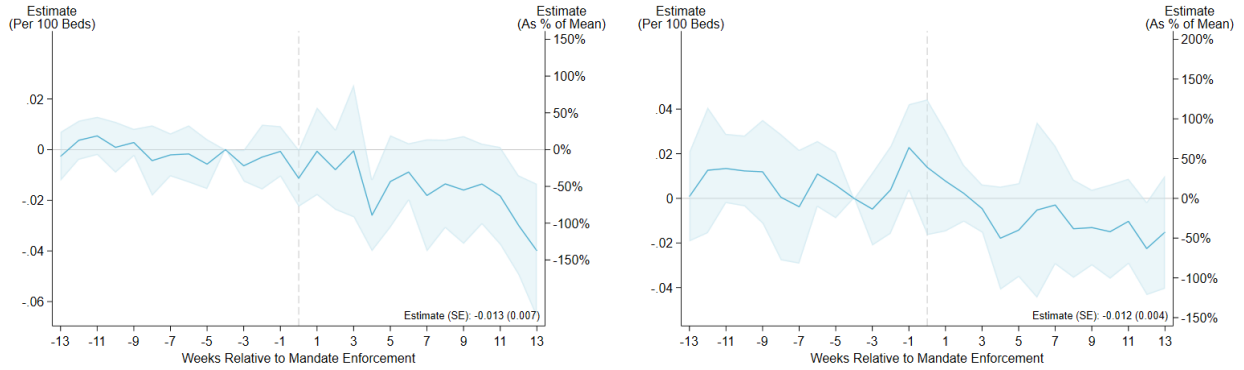
(a) Staff Size **(b) Hour Per Patient Day**



Notes. These figures plot stacked event study regressions which compare treated facilities that implemented a vaccination mandate relative to control facilities that did not implement a vaccination mandate. These analyses are restricted to chain operating nursing facilities. Regressions include week and facility fixed effects. Standard errors are clustered at the chain level. The y-axis on the left-hand side shows the change for each outcome relative to to the week when vaccination mandates were announced. The y-axis on the right-hand side represents the estimate as percent change relative to the week prior to the mandate announcement week. The x-axis illustrates the event-time relative to the week in which the chain's vaccination mandate was announced. The pooled estimate in the lower-right corner provides the difference between the post- and pre-treatment average coefficients.

Figure B41: Effect of Mandate Enforcement on CNA Staffing Changes Among Contract Workers

(a) Separations **(b) Hires**

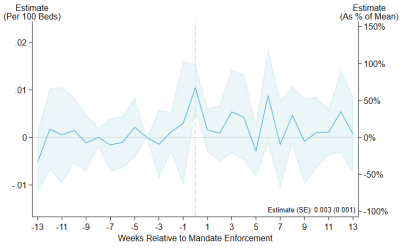


Notes. These figures plot stacked event study regressions which compare treated facilities that implemented a vaccination mandate relative to control facilities that did not implement a vaccination mandate. These analyses are restricted to contract workers. Regressions include week and facility fixed effects. Standard errors are clustered at the chain level. Estimates are computed relative to a baseline week that is 4 weeks prior to the mandate becoming enforced. Four weeks was the authorized interval between first and second dose for the Moderna vaccine. The y-axis on the left-hand side shows the change for each outcome relative to to the week when vaccination mandates were announced. The y-axis on the right-hand side represents the estimate as percent change relative to the week prior to the mandate announcement week. The x-axis illustrates the event-time relative to the week in which the chain's vaccination mandate was announced. The pooled estimate in the lower-right corner provides the difference between the post- and pre-treatment average coefficients.

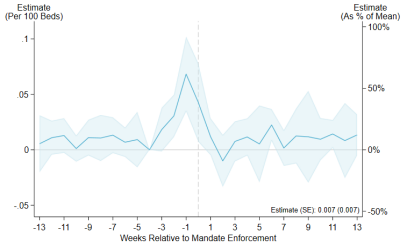
Figure B42: Effect of Mandate Enforcement on CNA Staffing Changes by Staff Type

Separations

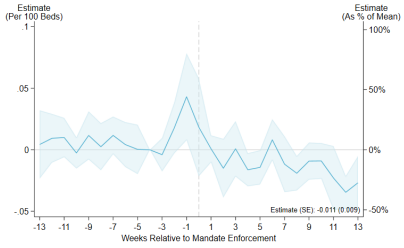
(a) Full-time Staff



(b) Part-time Staff

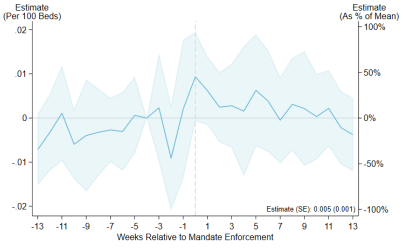


(c) Very Part-time Staff

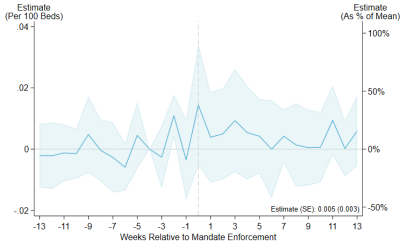


Hires

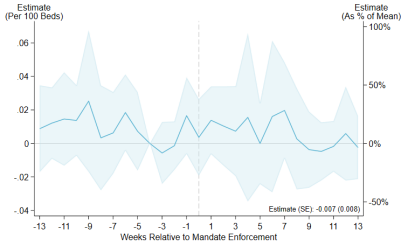
(d) Full-time Staff



(e) Part-time Staff



(f) Very Part-time Staff



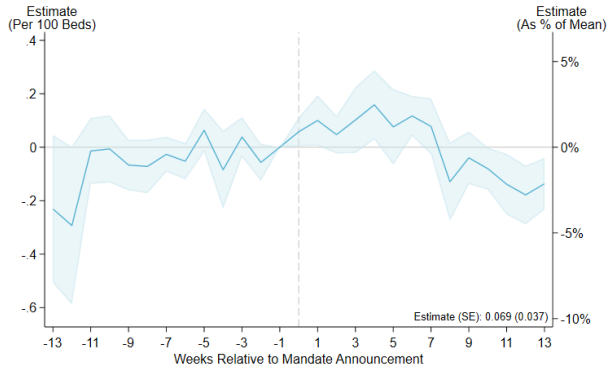
Notes. These figures plot stacked event study regression estimates comparing treated nursing homes that implemented a vaccination mandate relative to control nursing homes that did not implement a vaccination mandate. Regressions include nursing home and week fixed effects. Standard errors are clustered at the chain level. Estimates are computed relative to a baseline week that is 4 weeks prior to the mandate becoming enforced. Four weeks was the authorized interval between first and second dose for the Moderna vaccine. The left axes present the estimates, and the right axes present the estimates scaled by the mean of the outcome variable for treated nursing homes in the baseline week. The pooled estimate in the lower-right corner provides the difference between the post- and pre-treatment average coefficients. Full-time staff are those working 35+ hours per week, part-time staff are those working 20-34 hours per week, and very part-time staff are those working fewer than 20 hours per week.

B.9 Registered Nurses and Licensed Practical Nurses

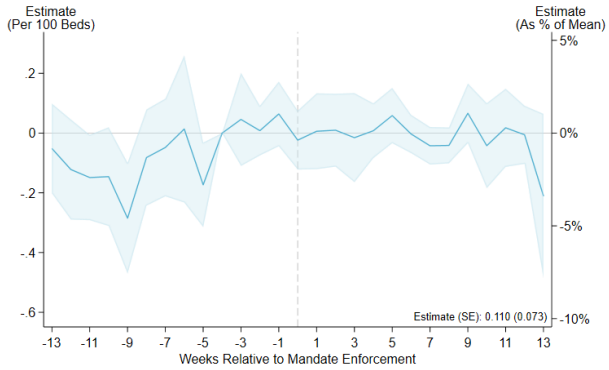
Figure B43: Effect of Mandates on RN Staffing Levels

Staff Size

(a) Mandate Announcement

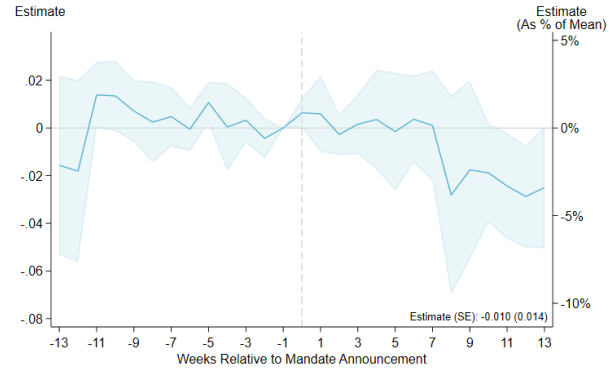


(b) Mandate Enforcement

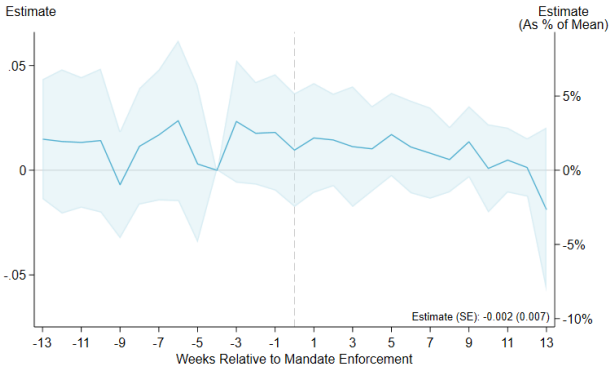


Hour Per Patient Day

(c) Mandate Announcement



(d) Mandate Enforcement

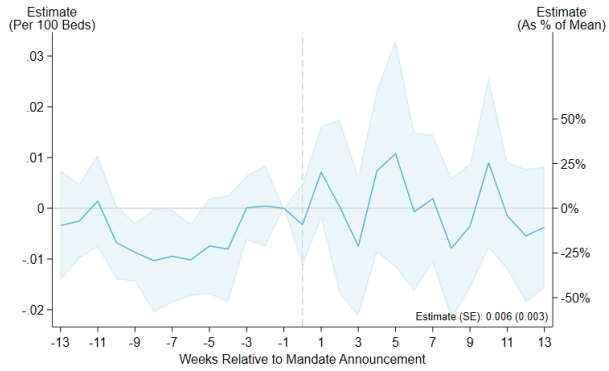


Notes. These figures plot event study regressions which compare treated facilities that implemented a vaccination mandate relative to control facilities that did not implement a vaccination mandate. Regressions include week and facility fixed effects. Standard errors are clustered at the chain level. The y-axis on the left-hand side shows the change for each outcome relative to to the week when vaccination mandates were announced in panels (a) and (c) and relative to four weeks prior to the week when vaccination mandates were enforced in panels (b) and (d). Four weeks prior to the mandate enforced week is used as the reference period because of potential anticipation effects. The y-axis on the right-hand side of panels (a) and (c) represents the estimate as percent change relative to the week prior to the mandate announcement week. The y-axis on the right-hand side of panels (b) and (d) represents the estimate as percent change relative to the four weeks prior to the mandate enforcement week. The x-axis illustrates the event-time relative to the week in which the chain's vaccination mandate was enforced. The pooled estimate in the lower-right corner provides the difference between the post- and pre-treatment average coefficients.

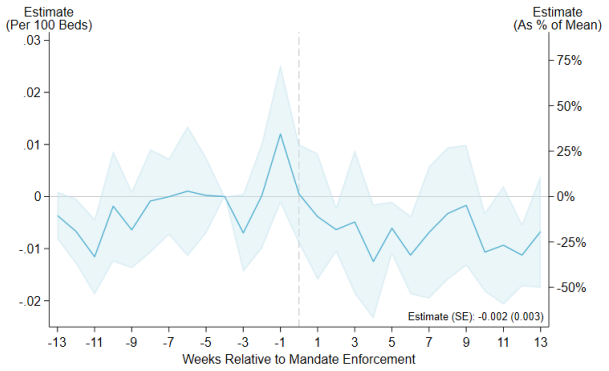
Figure B44: Effect of Mandates on RN Staffing Changes

Separations

(a) Mandate Announcement

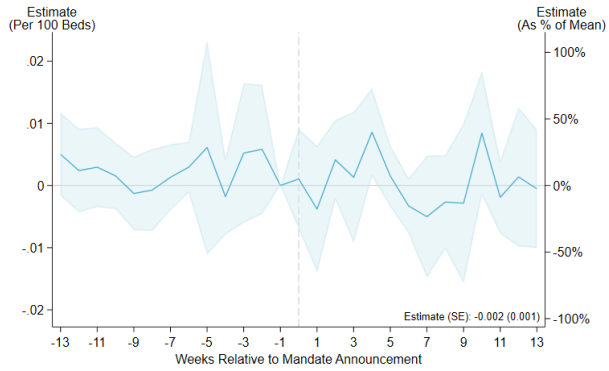


(b) Mandate Enforcement

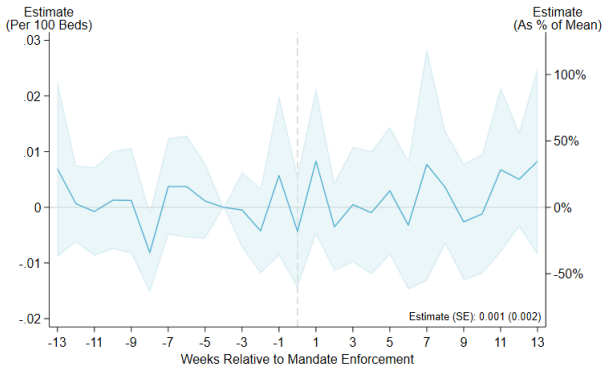


Hires

(c) Mandate Announcement



(d) Mandate Enforcement

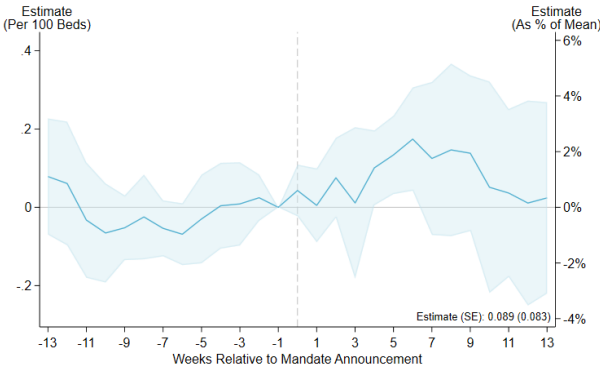


Notes. These figures plot event study regressions which compare treated facilities that implemented a vaccination mandate relative to control facilities that did not implement a vaccination mandate. Regressions include week and facility fixed effects. Standard errors are clustered at the chain level. The y-axis on the left-hand side shows the change for each outcome relative to to the week when vaccination mandates were announced in panels (a) and (c) and relative to four weeks prior to the week when vaccination mandates were enforced in panels (b) and (d). Four weeks prior to the mandate enforcement week is used as the reference period because of potential anticipation effects. The y-axis on the right-hand side of panels (a) and (c) represents the estimate as percent change relative to the week prior to the mandate announcement week. The y-axis on the right-hand side of panels (b) and (d) represents the estimate as percent change relative to the four weeks prior to the mandate effective week. The x-axis illustrates the event-time relative to the week in which the chain's vaccination mandate was enforced. The pooled estimate in the lower-right corner provides the difference between the post- and pre-treatment average coefficients.

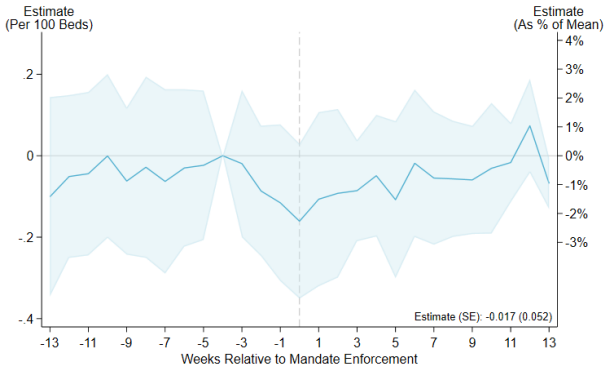
Figure B45: Effect of Mandates on LPN Staffing Levels

Staff Size

(a) Mandate Announcement

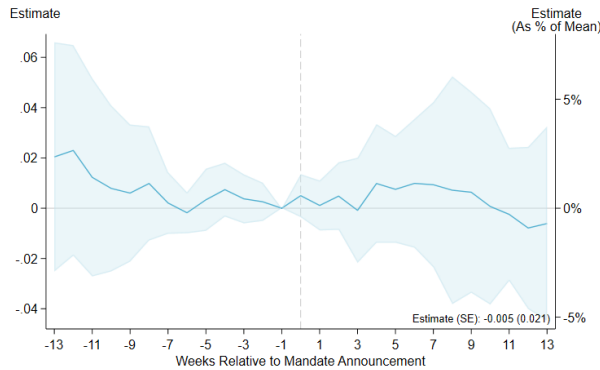


(b) Mandate Enforcement

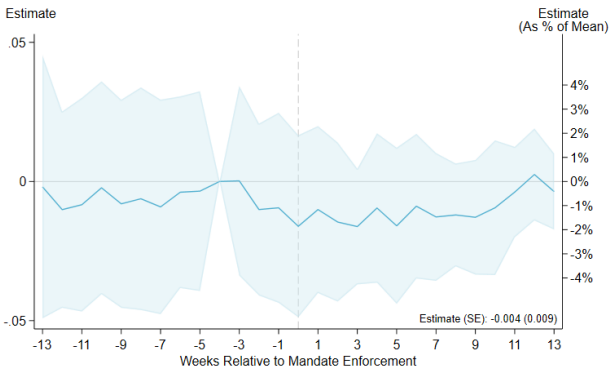


Hour Per Patient Day

(c) Mandate Announcement



(d) Mandate Enforcement

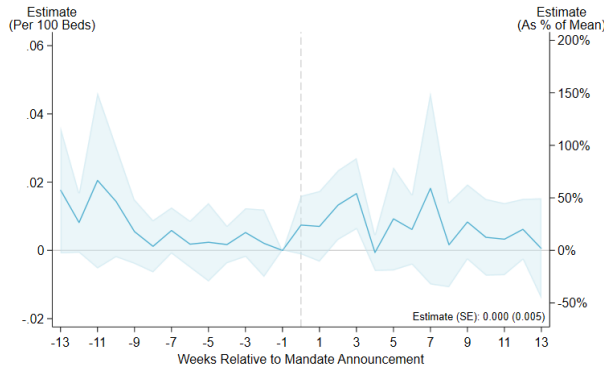


Notes. These figures plot stacked event study regressions which compare treated facilities that implemented a vaccination mandate relative to control facilities that did not implement a vaccination mandate. Regressions include week and facility fixed effects. Standard errors are clustered at the chain level. The y-axis on the left-hand side shows the change for each outcome relative to to the week when vaccination mandates were announced in panels (a) and (c) and relative to four weeks prior to the week when vaccination mandates were enforced in panels (b) and (d). Four weeks prior to the mandate effective week is used as the reference period because of potential anticipation effects. The y-axis on the right-hand side of panels (a) and (c) represents the estimate as percent change relative to the week prior to the mandate announcement week. The y-axis on the right-hand side of panels (b) and (d) represents the estimate as percent change relative to the four weeks prior to the mandate enforcement week. The x-axis illustrates the event-time relative to the week in which the chain's vaccination mandate was enforced. The pooled estimate in the lower-right corner provides the difference between the post- and pre-treatment average coefficients.

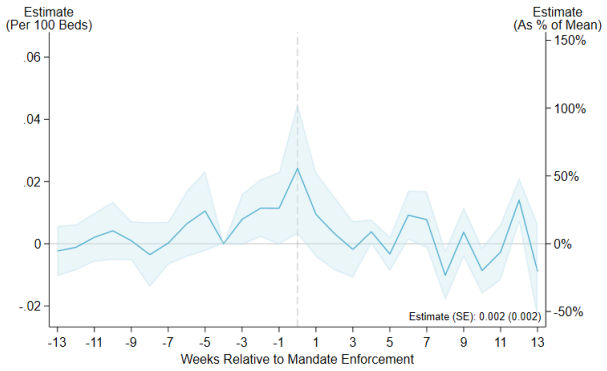
Figure B46: Effect of Mandates on LPN Staffing Changes

Separations

(a) Mandate Announcement

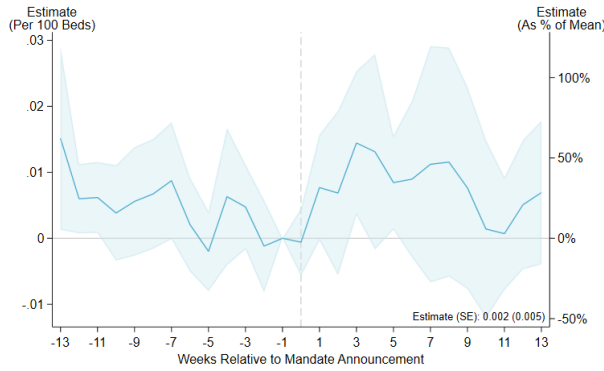


(b) Mandate Enforcement

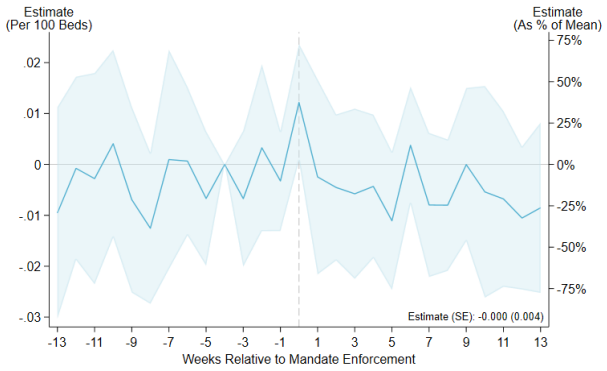


Hires

(c) Mandate Announcement



(d) Mandate Enforcement



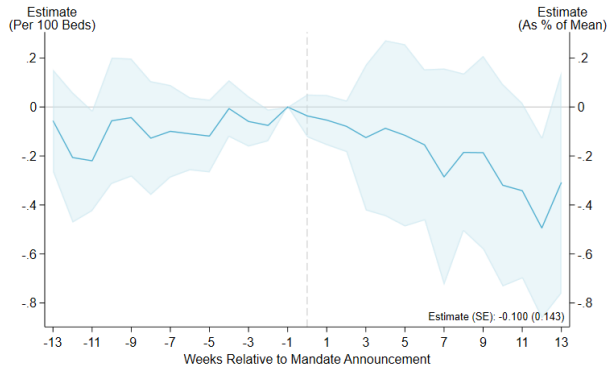
Notes. These figures plot stacked event study regressions which compare treated facilities that implemented a vaccination mandate relative to control facilities that did not implement a vaccination mandate. Regressions include week and facility fixed effects. Standard errors are clustered at the chain level. The y-axis on the left-hand side shows the change for each outcome relative to to the week when vaccination mandates were announced in panels (a) and (c) and relative to four weeks prior to the week when vaccination mandates were enforced in panels (b) and (d). Four weeks prior to the mandate enforcement week is used as the reference period because of potential anticipation effects. The y-axis on the right-hand side of panels (a) and (c) represents the estimate as percent change relative to the week prior to the mandate announcement week. The y-axis on the right-hand side of panels (b) and (d) represents the estimate as percent change relative to the four weeks prior to the mandate effective week. The x-axis illustrates the event-time relative to the week in which the chain's vaccination mandate was enforced. The pooled estimate in the lower-right corner provides the difference between the post- and pre-treatment average coefficients.

B.10 Effects by Length of Employment

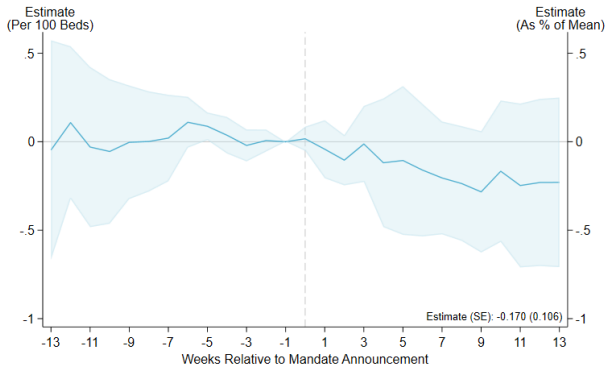
Figure B47: Effect of Mandate Announcement on CNA Staffing Levels By Length of Employment

Staff Size

(a) ≥500 hours

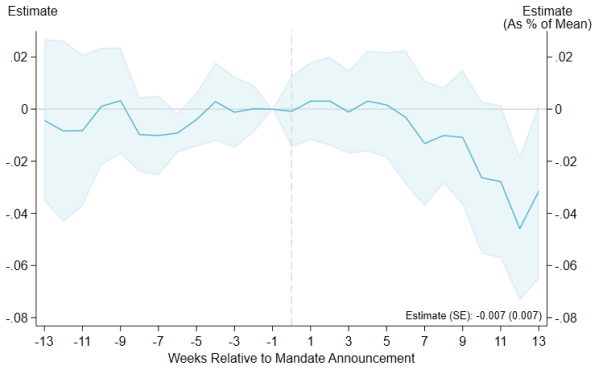


(b) <500 hours

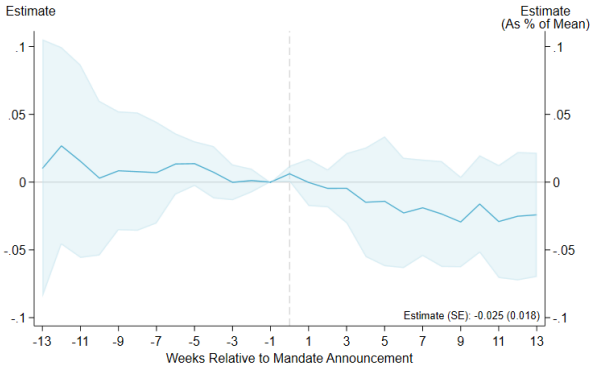


Hours Per Patient Day

(c) ≥500 hours



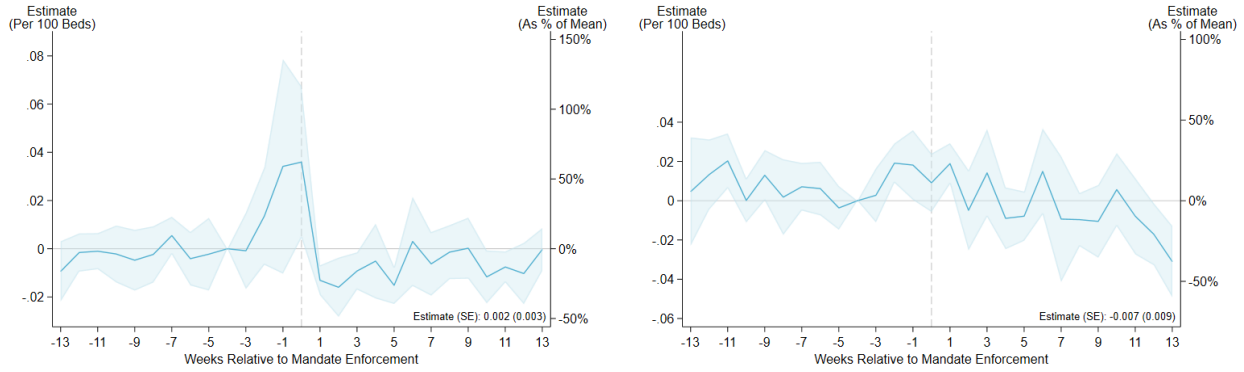
(d) <500 hours



Notes. These figures plot stacked event study regression estimates comparing treated nursing homes that implemented a vaccination mandate relative to control nursing homes that did not implement a vaccination mandate. Regressions include nursing home and week fixed effects. Standard errors are clustered at the chain level. Estimates are computed relative to a baseline one week prior to mandate announcement. The left axes present the estimates, and the right axes present the estimates scaled by the mean of the outcome variable for treated nursing homes in the baseline week. The pooled estimate in the lower-right corner provides the difference between the post- and pre-treatment average coefficients.

Figure B48: Effect of Mandate Enforcement on CNA Separations By Length of Employment

(a) ≥500 hours **(b) <500 hours**

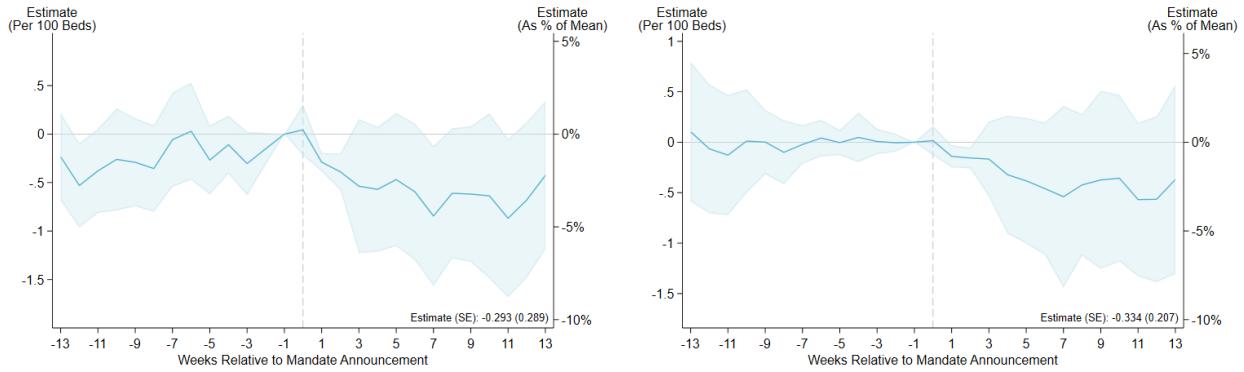


Notes. These figures plot stacked event study regression estimates comparing treated nursing homes that implemented a vaccination mandate relative to control nursing homes that did not implement a vaccination mandate. Regressions include nursing home and week fixed effects. Standard errors are clustered at the chain level. Estimates are computed relative to a baseline week that is 4 weeks prior to the mandate becoming enforced. Four weeks was the authorized interval between first and second dose for the Moderna vaccine. The left axes present the estimates, and the right axes present the estimates scaled by the mean of the outcome variable for treated nursing homes in the baseline week. The pooled estimate in the lower-right corner provides the difference between the post- and pre-treatment average coefficients.

B.11 Effects by Market Concentration

Figure B49: Effect of Mandate Announcement on Staff Size By Market Concentration

(a) HHI < 0.15 **(b) HHI ≥ 0.15**



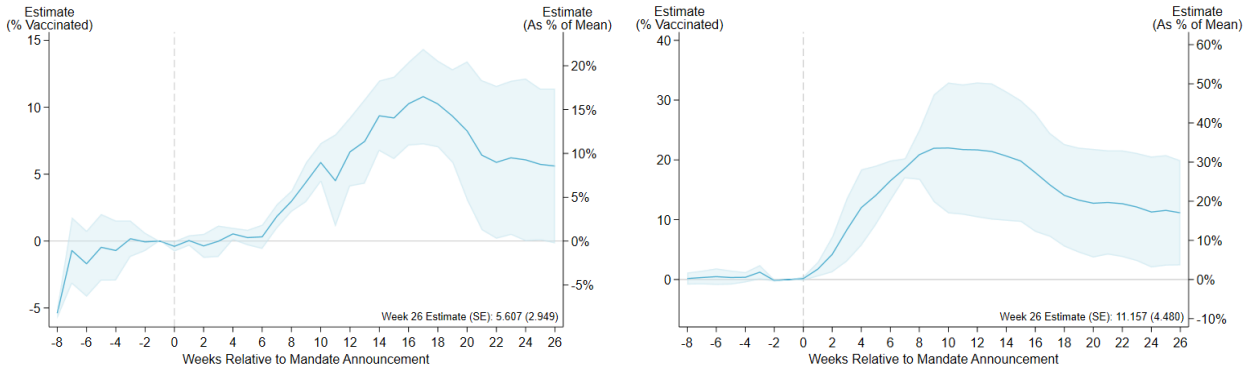
Notes. These figures plot stacked event study regressions which compare treated facilities that implemented a vaccination mandate relative to control facilities that did not implement a vaccination mandate. These analyses are restricted to chain operating nursing facilities. Regressions include week and facility fixed effects. Standard errors are clustered at the chain level. The y-axis on the left-hand side shows the change for each outcome relative to to the week when vaccination mandates were announced. The y-axis on the right-hand side represents the estimate as percent change relative to the week prior to the mandate announcement week. The x-axis illustrates the event-time relative to the week in which the chain's vaccination mandate was announced. The pooled estimate in the lower-right corner provides the difference between the post- and pre-treatment average coefficients.

B.12 Early versus Late Mandates

In this section, we explore the heterogeneity in effects between early and late mandates. For staffing-related outcomes, we find little evidence of meaningful differences in effects for early and late mandates. For vaccination rates, however, we find that the effect of announcement is smaller slightly delayed for early mandates. This difference may reflect the differing nature of obtaining vaccinations in each period. It was considerably more difficult to vaccinate through a public vaccination in early 2021 than in late 2021. To make access easier for nursing home staff during early 2021, The Federal Pharmacy Partnership for Long-Term Care made on-site vaccination clinics for staff at nursing homes. Therefore, staff induced to vaccinate by an early mandate likely needed to wait for an upcoming clinic. This may explain both the slightly delayed effect and smaller effect size that we estimate during this period.

Figure B50: Effect of Mandate Announcement on Staff Vaccination Rates

(a) Early Mandate **(b) Late Mandate**

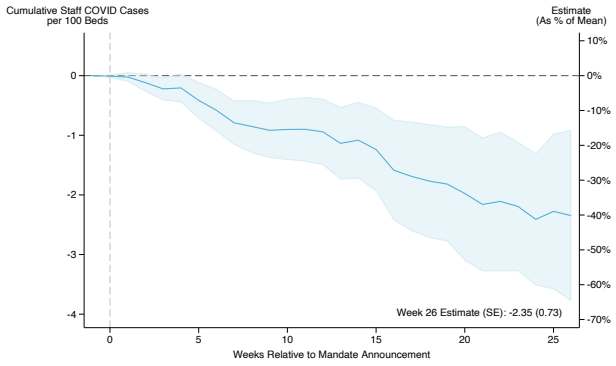


Notes. These figures plot stacked event study regression estimates comparing treated nursing homes that implemented a vaccination mandate relative to control nursing homes that did not implement a vaccination mandate. Regressions include nursing home and week fixed effects. Standard errors are clustered at the chain level. Estimates are computed relative to a baseline one week prior to mandate announcement. The left axes present the estimates, and the right axes present the estimates scaled by the mean of the outcome variable for treated nursing homes in the baseline week. Early mandate adopters are those that announced a mandate through July 30, 2021. Because the effect continues to grow at 13 weeks, we extend the panel for early mandates to include 26 weeks after mandate announcement. Late mandate adopters are those that announced a mandate in August 2021. Because vaccination rates were only reported beginning at the end of May 2021, these estimates use an event window that begins 8 weeks prior to mandate announcement. The estimate in the lower-right corner is the effect of the mandate 26 weeks post mandate announcement and enforcement.

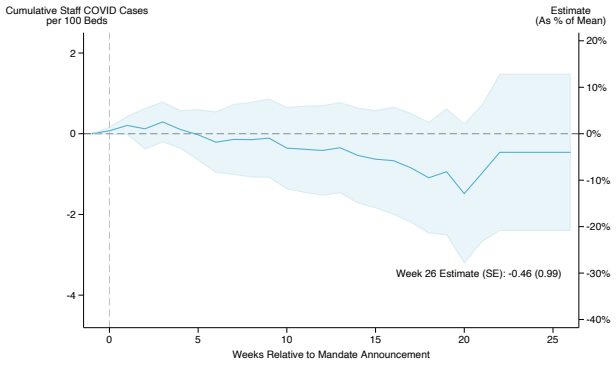
Figure B51: Effect of Mandate Announcement on COVID-19 Cases and Deaths

Staff Cases

(a) Early Mandate

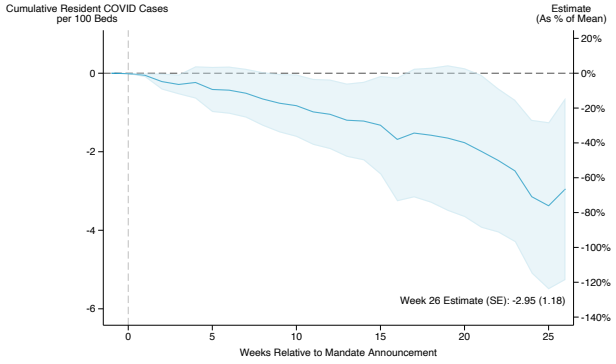


(b) Late Mandate

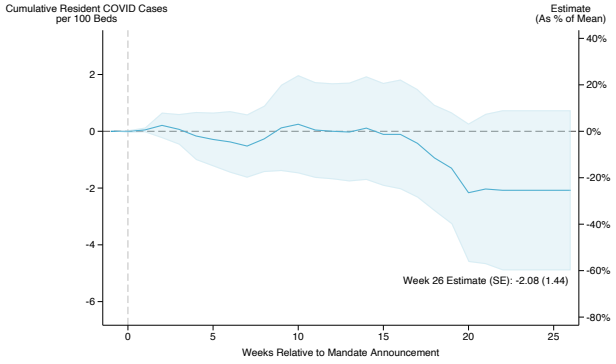


Resident Cases

(c) Early Mandate

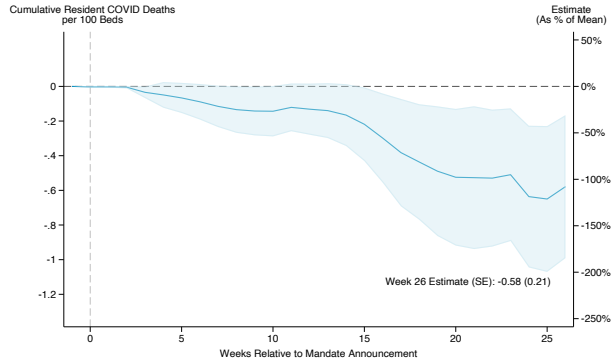


(d) Late Mandate

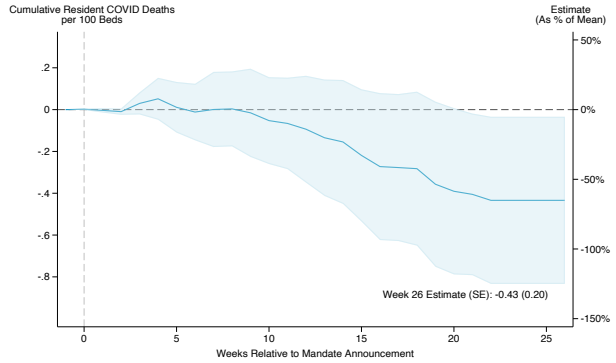


Resident Deaths

(e) Early Mandate



(f) Late Mandate

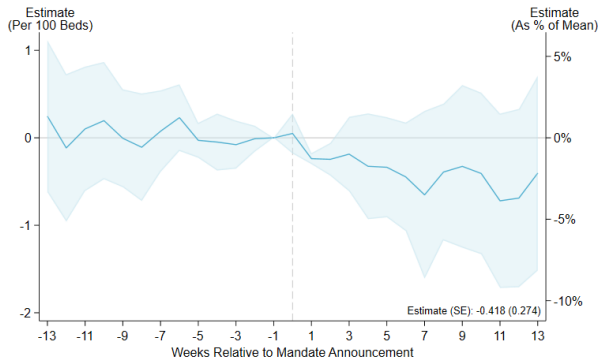


Notes. These figures plot stacked event study regression estimates comparing treated nursing homes that implemented a vaccination mandate relative to control nursing homes that did not implement a vaccination mandate. Regressions include nursing home and week fixed effects. Standard errors are clustered at the chain level. Estimates are computed relative to a baseline one week prior to mandate announcement. The left axes present the estimates, and the right axes present the estimates scaled by the mean of the outcome variable for treated nursing homes in the baseline week. Early mandate adopters are those that announced a mandate through July 30, 2021. Late mandate adopters are those that announced a mandate in August 2021.

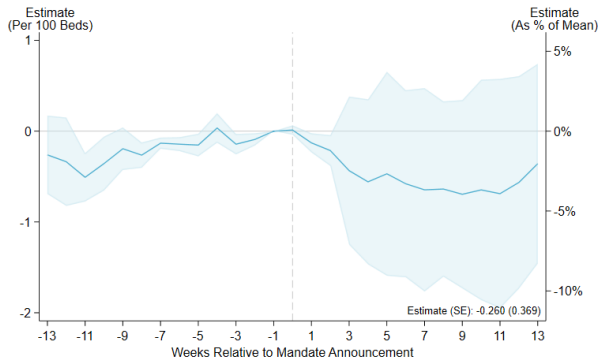
Figure B52: Effect of Mandate Announcement on Staffing Levels

Staff Size

(a) Early Mandate

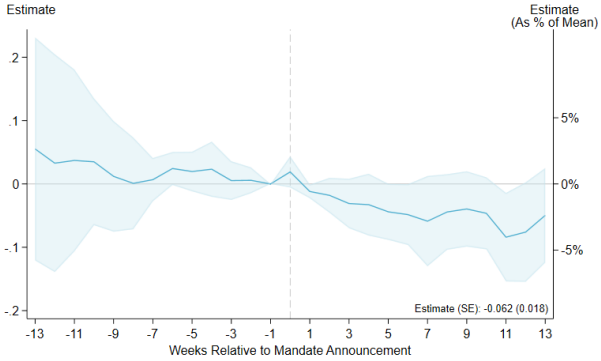


(b) Late Mandate

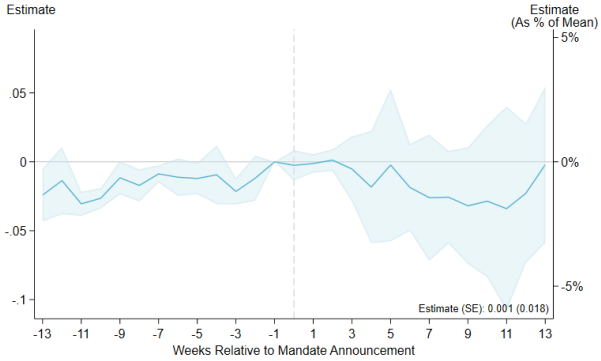


Hours Per Patient Day

(c) Early Announcement



(d) Late Announcement

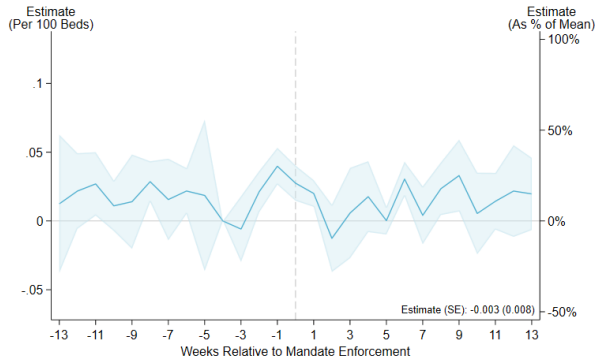


Notes. These figures plot stacked event study regression estimates comparing treated nursing homes that implemented a vaccination mandate relative to control nursing homes that did not implement a vaccination mandate. Regressions include nursing home and week fixed effects. Standard errors are clustered at the chain level. Estimates are computed relative to a baseline one week prior to mandate announcement. The left axes present the estimates, and the right axes present the estimates scaled by the mean of the outcome variable for treated nursing homes in the baseline week. Early mandate adopters are those that announced a mandate through July 30, 2021. Late mandate adopters are those that announced a mandate in August 2021. The pooled estimate in the lower-right corner provides the difference between the post- and pre-treatment average coefficients.

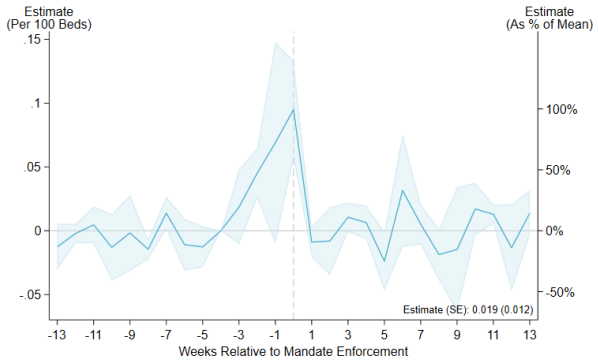
Figure B53: Effect of Mandate Enforcement on Staffing Changes

Separations

(a) Early Announcement

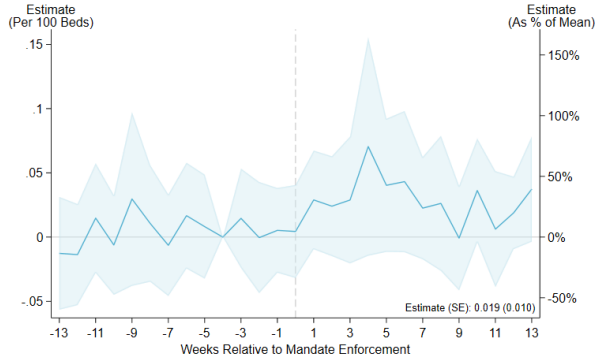


(b) Late Announcement

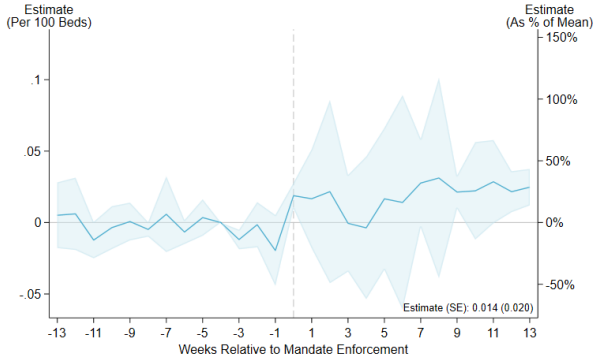


Hires

(c) Early Announcement



(d) Late Announcement

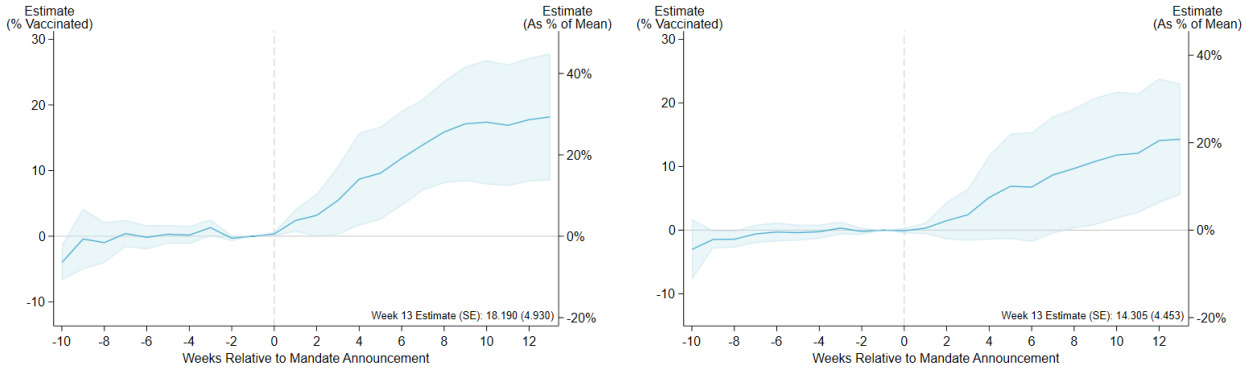


Notes. These figures plot stacked event study regression estimates comparing treated nursing homes that implemented a vaccination mandate relative to control nursing homes that did not implement a vaccination mandate. Regressions include nursing home and week fixed effects. Standard errors are clustered at the chain level. Estimates are computed relative to a baseline week that is 4 weeks prior to the mandate becoming enforced. Four weeks was the authorized interval between first and second dose for the Moderna vaccine. The left axes present the estimates, and the right axes present the estimates scaled by the mean of the outcome variable for treated nursing homes in the baseline week. Early mandate adopters are those that announced a mandate through July 30, 2021. Late mandate adopters are those that announced a mandate in August 2021. The pooled estimate in the lower-right corner provides the difference between the post- and pre-treatment average coefficients.

B.13 Effects of Mandates on Quality Measures and Health Inspections

Figure B54: Effect of Mandates on Staff Vaccination Rates by Provider Quality

(a) Low Quality **(b) High Quality**

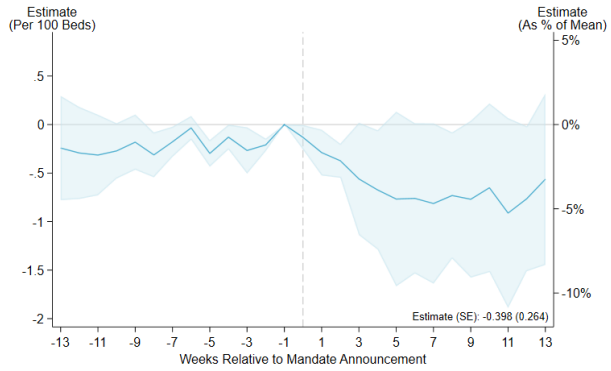


Notes. These figures plot stacked event study regression estimates comparing treated nursing homes that implemented a vaccination mandate relative to control nursing homes that did not implement a vaccination mandate, using data from Nursing Home Compare. The median star rating score was 3. "Low quality" nursing homes are those that received a star rating of 1 or 2, while "high-quality" nursing homes are those that received a star rating of 4 or 5 Regressions include nursing home and week fixed effects. Standard errors are clustered at the chain level. Estimates in are computed relative to a baseline one week prior to mandate announcement. The left axes present the estimates, and the right axes present the estimates scaled by the mean of the outcome variable for treated nursing homes in the baseline week. The estimate in the lower-right corner is the effect of the mandate 13 weeks post mandate announcement.

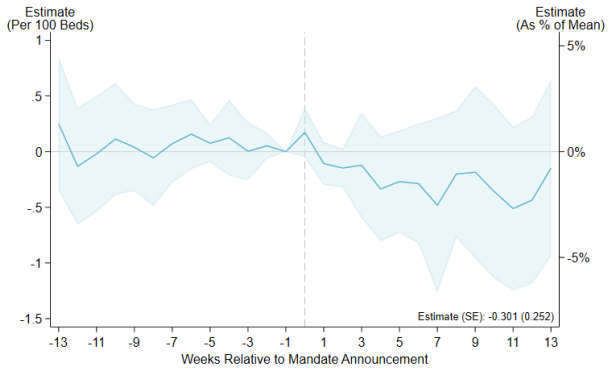
Figure B55: Effect of Mandates on Staffing Levels by Provider Quality

Staff Size

(a) Low Quality

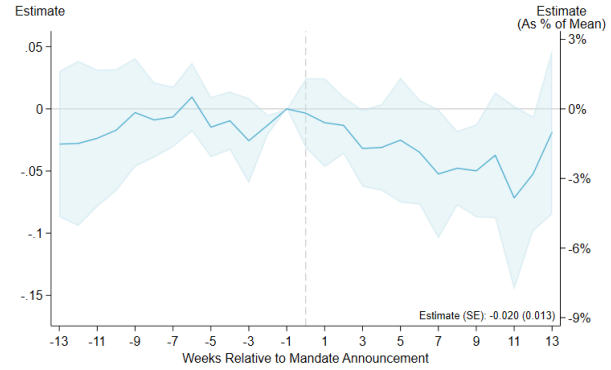


(b) High Quality

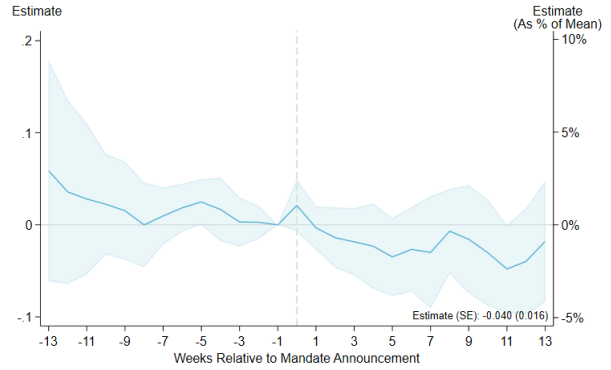


Hours Per Patient Day

(c) Low Quality



(d) High Quality

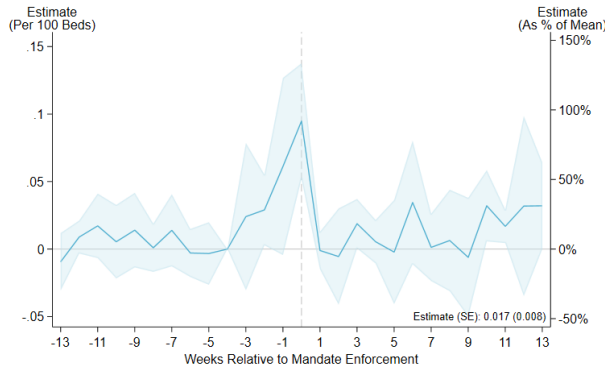


Notes. These figures plot stacked event study regression estimates comparing treated nursing homes that implemented a vaccination mandate relative to control nursing homes that did not implement a vaccination mandate, using data from Nursing Home Compare. The median star rating score was 3. "Low quality" nursing homes are those that received a star rating of 1 or 2, while "high-quality" nursing homes are those that received a star rating of 4 or 5. Regressions include nursing home and week fixed effects. Standard errors are clustered at the chain level. Estimates in are computed relative to a baseline one week prior to mandate announcement. The left axes present the estimates, and the right axes present the estimates scaled by the mean of the outcome variable for treated nursing homes in the baseline week. The pooled estimate in the lower-right corner provides the difference between the post- and pre-treatment average coefficients.

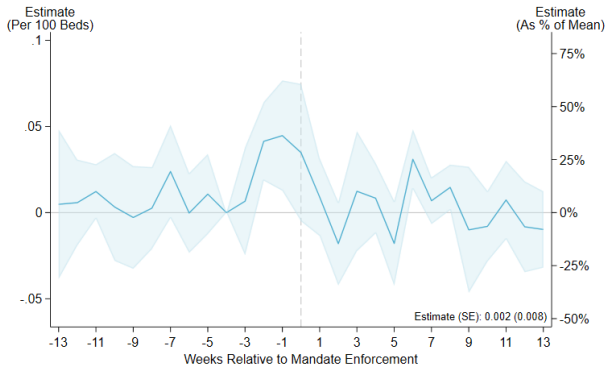
Figure B56: Effect of Mandates on Staffing Changes by Provider Quality

Separations

(a) Low Quality

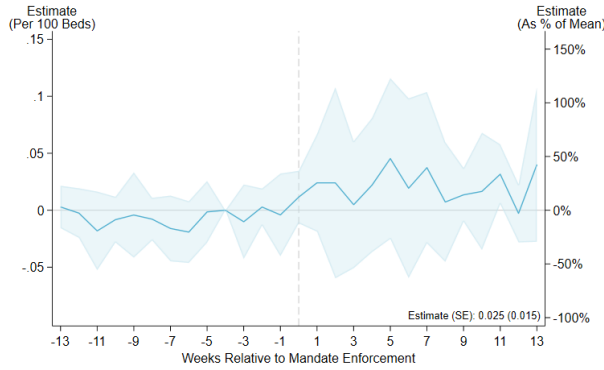


(b) High Quality

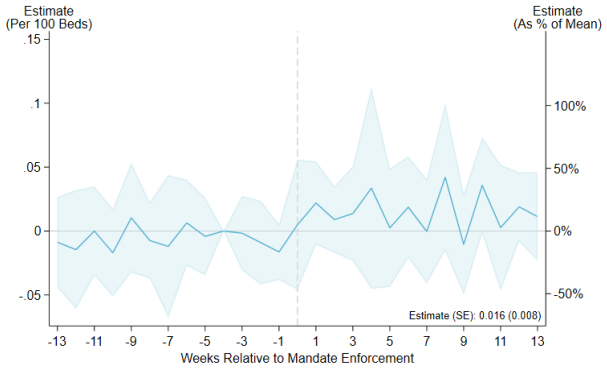


New Hires

(c) Low Quality



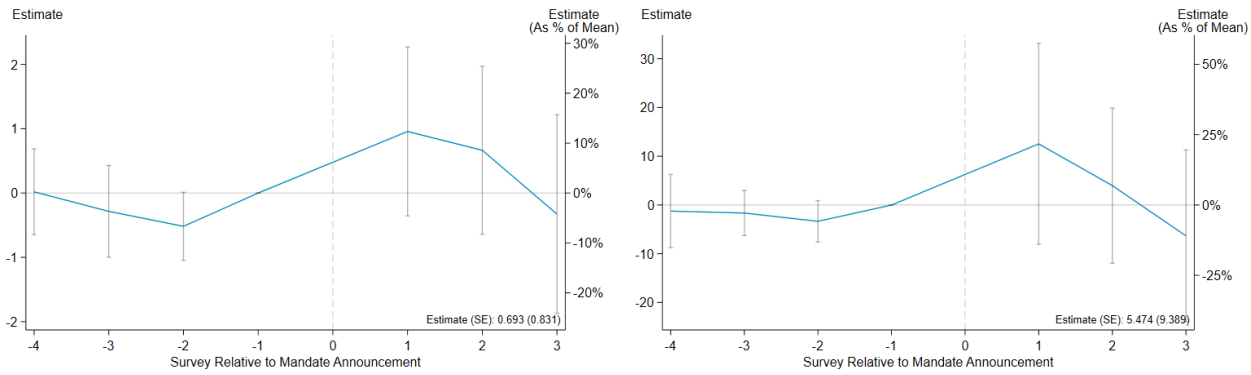
(d) High Quality



Notes. These figures plot stacked event study regression estimates comparing treated nursing homes that implemented a vaccination mandate relative to control nursing homes that did not implement a vaccination mandate, using data from Nursing Home Compare. The median star rating score was 3. "Low quality" nursing homes are those that received a star rating of 1 or 2, while "high-quality" nursing homes are those that received a star rating of 4 or 5 Regressions include nursing home and week fixed effects. Standard errors are clustered at the chain level. Estimates in are computed relative to a baseline one week prior to mandate announcement. The left axes present the estimates, and the right axes present the estimates scaled by the mean of the outcome variable for treated nursing homes in the baseline week. The pooled estimate in the lower-right corner provides the difference between the post- and pre-treatment average coefficients.

Figure B57: Effect of Mandate Announcement on Health Inspections

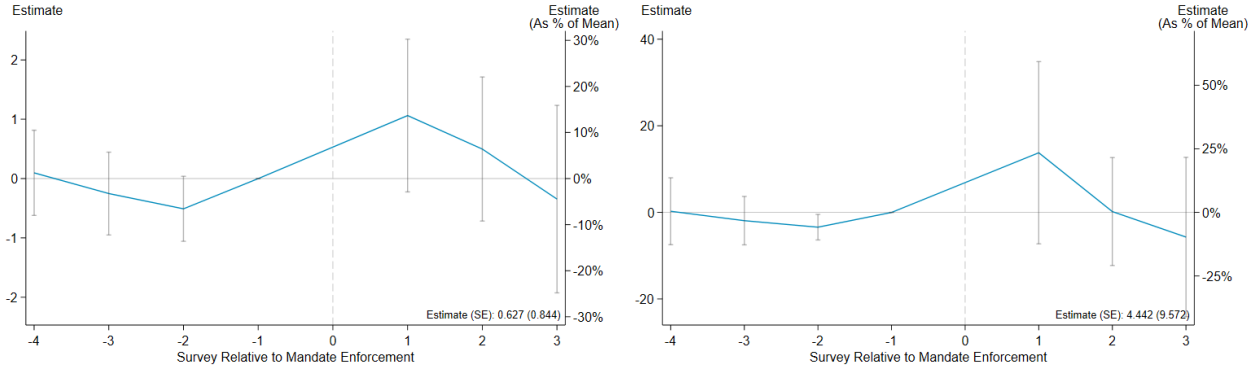
(a) Count of Deficiencies **(b) Total Score**



Notes. These figures plot stacked event study regression estimates comparing treated nursing homes that implemented a vaccination mandate relative to control nursing homes that did not implement a vaccination mandate, using data from Nursing Home Compare. Regressions include nursing home and week fixed effects. Standard errors are clustered at the chain level. Estimates in are computed relative to a baseline survey prior to mandate announcement. The left axes present the estimates, and the right axes present the estimates scaled by the mean of the outcome variable for treated nursing homes at the baseline survey. The pooled estimate in the lower-right corner provides the difference between the post- and pre-treatment average coefficients.

Figure B58: Effect of Mandate Enforcement on Health Inspections

(a) Count of Deficiencies **(b) Total Score**

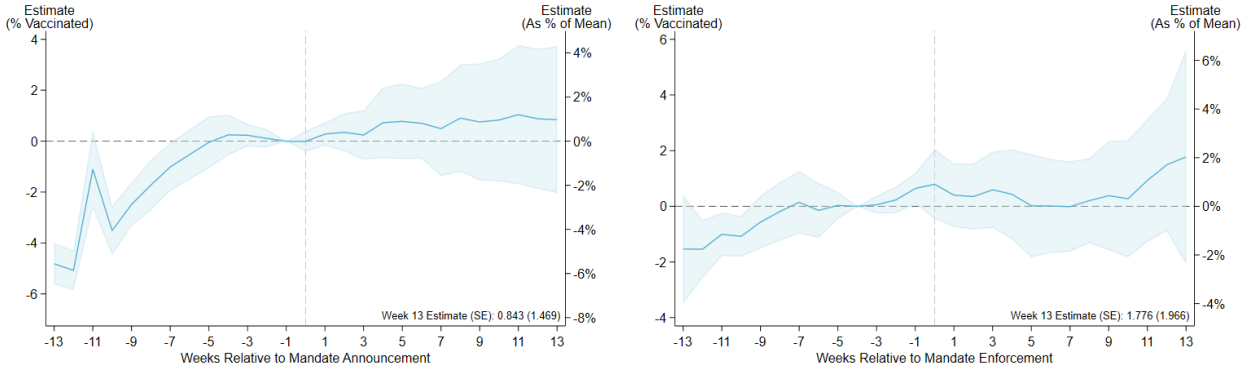


Notes. These figures plot stacked event study regression estimates comparing treated nursing homes that implemented a vaccination mandate relative to control nursing homes that did not implement a vaccination mandate, using data from Nursing Home Compare. Regressions include nursing home and week fixed effects. Standard errors are clustered at the chain level. Estimates in are computed relative to a baseline survey prior to mandate enforcement. The left axes present the estimates, and the right axes present the estimates scaled by the mean of the outcome variable for treated nursing homes at the baseline survey. The pooled estimate in the lower-right corner provides the difference between the post- and pre-treatment average coefficients.

B.14 Other Outcomes and Results

Figure B59: Effect of Mandates on Resident Vaccination Rates

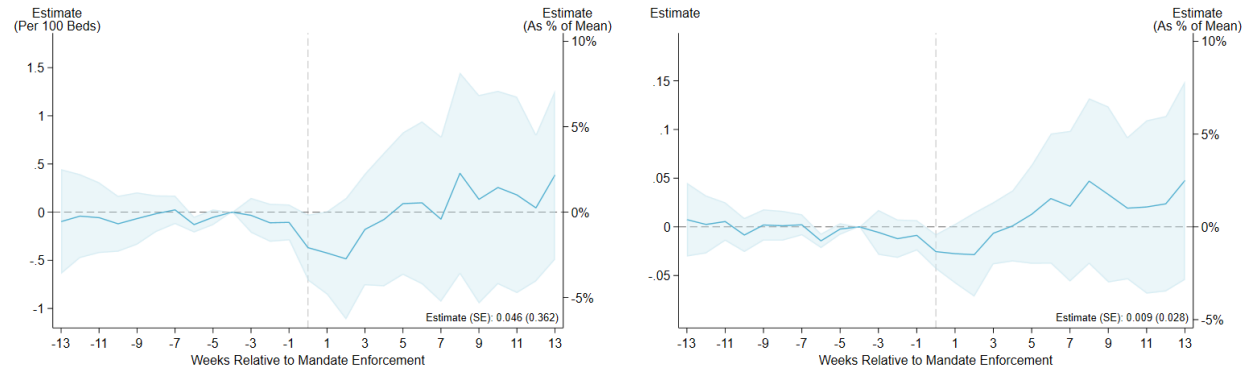
(a) Mandate Announcement **(b) Mandate Enforcement**



Notes. These figures plot event study regression estimates comparing treated facilities that implemented a vaccination mandate relative to control facilities that did not implement a vaccination mandate. Regressions include facility and week fixed effects. Standard errors are clustered at the chain level. Estimates are computed relative to a baseline one week prior to mandate announcement. The y-axis on the left-hand side shows the change for each outcome relative to to the week when vaccination mandates were announced. The y-axis on the right-hand side represents the estimate as percent change relative to the week prior to the mandate announcement week. The x-axis illustrates the event-time relative to the week in which the chain's vaccination mandate was announced. The estimate in the lower-right corner is the effect of the mandate 13 weeks post mandate announcement and enforcement.

Figure B60: Effect of Mandate Enforcement on CNA Staffing Levels

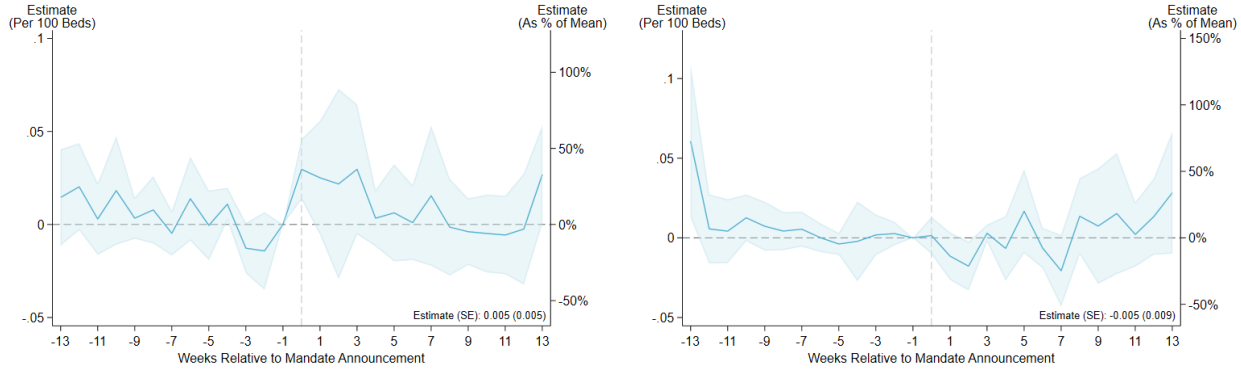
(a) Staff Size **(b) Hours Per Patient Day**



Notes. These figures plot stacked event study regression estimates comparing treated nursing homes that implemented a vaccination mandate relative to control nursing homes that did not implement a vaccination mandate. Regressions include nursing home and week fixed effects. Standard errors are clustered at the chain level. Estimates are computed relative to a baseline week that is 4 weeks prior to the mandate becoming enforced. Four weeks was the authorized interval between first and second dose for the Moderna vaccine. The left axes present the estimates, and the right axes present the estimates scaled by the mean of the outcome variable for treated nursing homes in the baseline week. The mean staff size per 100 beds in the week prior to mandate announcement was 18.11(SD= 5.33). The mean hours per patient day in the week prior to mandate announcement was 1.96(SD= 0.47). The pooled estimate in the lower-right corner provides the difference between the post- and pre-treatment average coefficients.

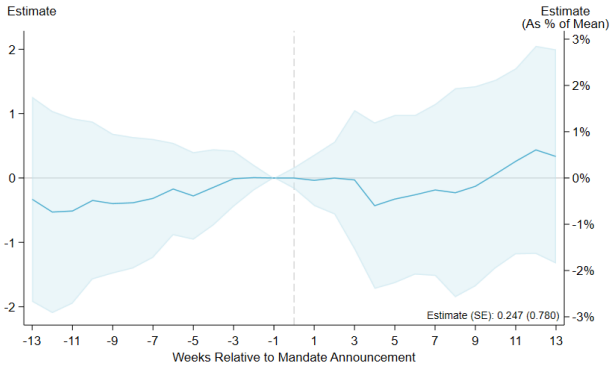
Figure B61: Effect of Mandate Announcement on CNA Separations and Hiring

(a) Separations **(b) Hires**



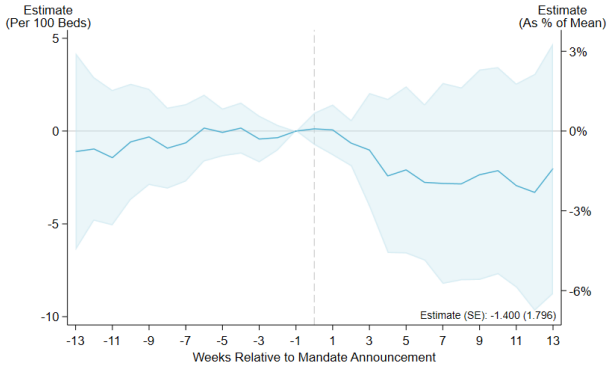
Notes. These figures plot stacked event study regression estimates comparing treated nursing homes that implemented a vaccination mandate relative to control nursing homes that did not implement a vaccination mandate. Regressions include nursing home and week fixed effects. Standard errors are clustered at the chain level. Estimates are computed relative to a baseline one week prior to mandate announcement. The left axes present the estimates, and the right axes present the estimates scaled by the mean of the outcome variable for treated nursing homes in the baseline week. The pooled estimate in the lower-right corner provides the difference between the post- and pre-treatment average coefficients.

Figure B62: Effect of Mandate Announcement on Nursing Home Occupancy



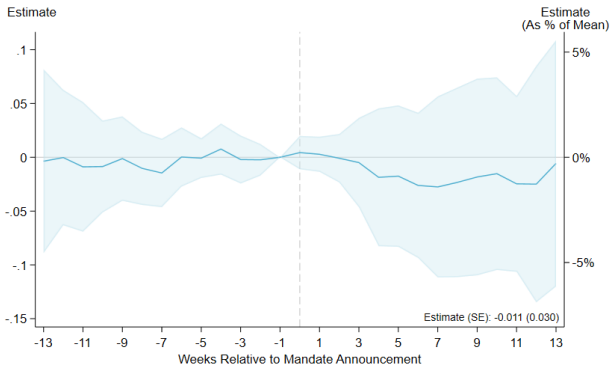
Notes. These figures plot stacked event study regression estimates comparing treated nursing homes that implemented a vaccination mandate relative to control nursing homes that did not implement a vaccination mandate. Regressions include nursing home and week fixed effects. Standard errors are clustered at the chain level. Estimates are computed relative to a baseline one week prior to mandate announcement. The left axes present the estimates, and the right axes present the estimates scaled by the mean of the outcome variable for treated nursing homes in the baseline week. The pooled estimate in the lower-right corner provides the difference between the post- and pre-treatment average coefficients.

Figure B63: Effect of Mandate Announcement on CNA Hours Per 100 Beds



Notes. These figures plot stacked event study regression estimates comparing treated nursing homes that implemented a vaccination mandate relative to control nursing homes that did not implement a vaccination mandate. Regressions include nursing home and week fixed effects. Standard errors are clustered at the chain level. Estimates are computed relative to a baseline one week prior to mandate announcement. The left axes present the estimates, and the right axes present the estimates scaled by the mean of the outcome variable for treated nursing homes in the baseline week. The pooled estimate in the lower-right corner provides the difference between the post- and pre-treatment average coefficients.

Figure B64: Effect of Mandate Announcement on Hours Per Patient Day - Occupancy Denominator Fixed at Event Time -1



Notes. These figures plot stacked event study regression estimates comparing treated nursing homes that implemented a vaccination mandate relative to control nursing homes that did not implement a vaccination mandate. Regressions include nursing home and week fixed effects. Standard errors are clustered at the chain level. Estimates are computed relative to a baseline one week prior to mandate announcement. The left axes present the estimates, and the right axes present the estimates scaled by the mean of the outcome variable for treated nursing homes in the baseline week. The pooled estimate in the lower-right corner provides the difference between the post- and pre-treatment average coefficients.