Helping Nurses or Hurting Patients:

The Effect of Workplace Inspections in Nursing Facilities

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Abstract

This study examines the effect of inspections on workplace safety, service quality, and worker productivity in nursing facilities. The identification strategy exploits a nationwide program of the Occupational Safety and Health Administration (OSHA), which prioritized establishments for inspection if their injury rates exceeded a threshold. Using a regression discontinuity design and matched establishment-level data from OSHA and the Centers for Medicare & Medicaid Services (CMS), I find inspections are associated with lower nurse injury rates, but worse healthcare quality and lower nurse productivity. The results suggest improving workplace safety may come at the expense of service quality and worker productivity.

Keywords: Workplace Safety, Healthcare Quality, Worker Productivity, Nursing Facilities

JEL Classifications: J28, J24, I10

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Instructions on obtaining the data and copies of the computer programs are available upon request.

1. Introduction

Workplace inspections and the associated penalties are the government's primary tools to reduce workplace injuries, which cost $206 billion annually in wage and productivity losses, medical expenditures, and administrative expenses (National Safety Council, 2015). While the goal of inspections is to reduce workplace injuries and the associated costs, improvements in safety may have an unintended effect on product quality and worker productivity. On one hand, improvements in safety may be achieved through enhanced production practice or technology, which may increase product quality and worker productivity (Black and Lynch, 2001). On the other hand, improvements in safety may require additional effort devoted to compliance and precautions (Krueger, 1990), which may subsequently decrease product quality and worker productivity. Thus, the net effect of workplace inspections on product quality and worker productivity is ambiguous.

This study provides empirical evidence on the effect of workplace inspections by the Occupational Safety and Health Administration (OSHA) on workplace safety, product quality, and worker productivity. The empirical analysis focuses on nursing facilities, an industry with one of the highest workplace injury rates. In 2016, the 3.3 million workers employed in nursing facilities experienced on average 6.2 cases of workplace injuries or illnesses per 100 full-time equivalent employees, much higher than the 3.3 cases in manufacturing and the 3.0 cases as the national average (BLS, 2017, BLS, 2018). More importantly, these injuries come predominantly from nurses providing direct care for residents. In particular, 44 percent of the injuries in health care facilities comes from patient handling and movement, and 37 percent comes from slips, falls, and trips (Gomaa et al., 2015). During the inspections in nursing facilities, OSHA identifies violations of both general safety standards and hazards specific to nursing facilities, including

musculoskeletal disorders and slips, trips, and falls. Inspections and the associated financial penalties may incentivize the facilities to reduce injuries. However, effort to reduce injuries, such as adjustments in the practice of moving and handling patients, could directly affect the quality of healthcare in the inspected facilities.

Empirically, the challenge of identifying the causal effect of OSHA inspections is that inspections are not conducted randomly. Typically, inspections are conducted more frequently in more dangerous firms (Kniesner and Leeth, 2014), generating a negative correlation between inspections and workplace safety. In addition, inspections may be more frequently conducted in establishments with less efficient managers or lower quality workers, generating a negative correlation between inspections and product quality, and between inspections and worker productivity. These cross-sectional correlations would confound the causal effect of inspections on safety, quality, and productivity.

To overcome these concerns, this study exploits the design of OSHA's Site-Specific Targeting (SST) plan. The SST plan is the first nation-wide program that targeted establishments for inspection based on establishment-level injury case rate. From 1996, OSHA surveyed the annual workplace injury case rates of around 80,000 establishments each year through the OSHA Data Initiative (ODI). Based on the case rates reported in ODI, OSHA prioritized establishments for inspection if the case rates exceeded a threshold. Importantly, the SST threshold was selected only after collecting the injury case rates, preventing employers from manipulating their injury case rates to avoid inspection. By design, the SST plan generated a discontinuous increase in the likelihood of inspections at the SST threshold.

The identification strategy exploits the discontinuous increase in inspections at the SST threshold using a fuzzy regression discontinuity (FRD) design. The key identification assumption

is that establishments with injury case rates right above and below the SST threshold are comparable. The assumption is examined by testing the smoothness of the distribution of the establishments and the establishment characteristics at the SST threshold. The FRD design uses the SST threshold as an instrument for whether an establishment has an inspection, which identifies the local average treatment effect among compliers with injury case rates close to the SST threshold.

To implement the FRD design, a unique establishment-level dataset is constructed by linking surveys on injury case rates to administrative records on inspections and a census of nursing facilities. The injury case rates of the facilities covered by the SST plan are from ODI. The inspection records are from OSHA's Integrated Management Information System (IMIS). The quality measures and staffing levels are from a census of the nursing facilities complied by the Centers for Medicare & Medicaid Services (CMS). The linked data include 11,832 facility-year observations, which provide a large representative sample for estimating the effect of inspections on worker safety and service quality.

According to the matched data of injury case rates and inspection records, the SST plan is associated with a 32 percentage point increase in the likelihood of inspections at the SST threshold. Moreover, the distribution of facilities is smooth at the threshold and the establishment characteristics are similar above and below the threshold, suggesting the identification assumption of FRD design is valid.

The estimates using the FRD design suggest that inspections improve workplace safety. After inspections, the number of cases involving days away from work, job restrictions or transfer (DART) is estimated to decrease significantly by 5.6 cases per 100 full-time equivalent employees, representing a 38 percent decrease compared with the average DART at the

threshold. The results suggest OSHA inspections are effective in improving workplace safety in facilities with injury case rates close to the SST threshold.

While inspections improve workplace safety, they negatively affect the quality of care. First, inspections are associated with an 18.3 percentage point increase in deficiency citations on providing ADL care, representing a more than two hundred percent increase. Second, inspections are associated with a significant decrease in the number of residents receiving full assistance with ADLs. This may reflect that nurses avoid injuries by reducing ADL care, as patient handling and moving account for nearly half of the nurse injuries. The residents also show more skin rashes and more behavioral symptoms after inspections. Overall, the results imply a negative impact of inspections on the quality of care in nursing facilities.

The results also suggest that workplace inspections decrease worker productivity. The productivity of nurses is approximated using quality-adjusted output per labor hour (Sojourner et al., 2015).[1] After inspections, nursing facilities serve the same number of residents while the quality of care worsens, evidenced by lower quality of ADL care and worse health outcomes. Additionally, labor input, measured by the number of nursing hours per resident, does not change. Taken together, the results suggest that inspections have a negative impact on worker productivity.

[1] Only a few studies present empirical evidence on the productivity of health care personnel since the output, namely the healthcare provided to patients, is difficult to quantify. Previous empirical studies adopt different measures on productivity: Skinner and Staiger (2015) use one-year survival of the patients, Tong (2011) use mortality, and Bartel et al. (2014) use the length of stay in hospital. However, none of these measures take labor input into account directly.

This study provides the first evidence on the trade-off between workplace safety and worker productivity in the service sector. Previous studies focus exclusively on firms in manufacturing, construction, and mining (Sider, 1983; Gray, 1987; Kaminski, 2001; Gowrisankaran et al., 2018). A close study to this paper is Gowrisankaran et al. (2017), which find fatal accidents in coal mines are associated with fewer injuries and lower miner productivity. Fatal accidents may affect worker productivity through channels not directly related to workplace safety, such as increased media exposure and temporary mine closures. The advantage of this study is that the variation of safety is derived from regular workplace inspections, which are less likely to cause dramatic changes in factors other than the enforcement of safety standards.

This study also highlights the unintended effect of nurse safety regulations on healthcare quality. Considerable research has shown the important role of nurses in providing high quality health care. Factors such as the number of nurses (Lin, 2014), the composition of the nursing team (Bartel et al., 2014), and the pay regulation of nurses (Propper and Van Reenen, 2010) affect the quality of care and patient outcomes significantly. As nurses are injured mostly from providing direct care for residents, regulations aimed at reducing workplace injuries among nurses are likely to have a negative impact on the quality of care provided for the patients.

The rest of this paper proceeds as follows. Section 2 provides the background on OSHA inspections and the Site-Specific Targeting (SST) plan of OSHA. Section 3 presents the data and descriptive statistics. Section 4 discusses the empirical method. Section 5 presents the results and Section 6 concludes.

2. OSHA Inspections and Site-Specific Targeting Plan

The Occupational Safety and Health Administration (OSHA), created after the passage of the Occupational Safety and Health Act of 1970, is a federal agency with the mission of assuring safe and healthful working conditions for workers. OSHA developed a series of workplace health and safety standards that most private sector employers and some public sector employers are obliged to obey.[2] To enforce these standards, OSHA conducts about 80,000 inspections annually.

OSHA inspections are likely to improve workplace safety for various reasons. First, OSHA always conducts inspections without any advance notice[3], making it difficult for employers to act strategically before the inspections. Second, in more than 60 percent of the inspections, OSHA finds violations of safety and health standards[4], which may lead to penalties up to $12,934 per violation. OSHA mandates the employers to correct the violations within a time limit. Inspections also increase the financial penalty of each repeated violation to up to $129,336. In addition to detecting violations, inspections raise managerial attention to general occupational safety issues, even those not directly related to specific violations found in inspections (Mendeloff and Gray, 2005). Overall, OSHA inspections provide incentives from various aspects for the employers to improve safety conditions and reduce workplace injuries.

[2] Federal OSHA plan only covers workers in the private sector and federal government. Twenty-six states have their own state plans to cover workers at state and local government agencies.

[3] OSHA may give notices for special circumstances, usually less than 24 hours in advance. In the analysis sample, only 0.4 percent of the programmed inspections were noticed in advance.

[4] Author's calculation based on the inspections from 1999 to 2014. Data are from OSHA's Integrated Management Information System (IMIS).

OSHA inspections fall into two general categories: programmed inspections and unprogrammed inspections. Programmed inspections, constituting 56 percent of OSHA inspections, are typically conducted based on establishment industry, potential hazards, or injury case rates, and are mostly complete inspections on all potential hazards. Unprogammed inspections are conducted based on employee complaints, accidents, or referrals. Unprogrammed inspections only focus on hazards specific to the incidents.

To identify the effect of OSHA inspections, this study exploits the design of OSHA's Site-Specific Targeting (SST) plan. The SST plan is OSHA's first nation-wide program that conducted comprehensive inspections based on establishment-level injury case rate (OSHA, 2004). Starting from 1996, OSHA used its annual OSHA Data Initiative (ODI) survey to collect establishment-level injury case rates. OSHA requires most firms to keep a log of all recordable workplace injuries.[5] In each year, OSHA selected about 80,000 establishments in industries with historically higher injury rates[6] and required the employers to report the total number of injury cases (TCR) and the number of cases involving days away from work, job transfers or

[5] OSHA recordable injuries include any work-related fatality; any work-related injury or illness that results in loss of consciousness, days away from work, restricted work, or transfer to another job; and any work-related injury or illness requiring medical treatment beyond first aid.

[6] The industries include manufacturing and non-construction industries with injury rates above the national average, selected based on industry level rate of nonfatal occupational injuries and illnesses from Bureau of Labor Statistics. 60 percent of the establishments in ODI are in manufacturing, 15 percent in services, 11 percent in transportation and communications, 8 percent in wholesale trade, and 5 percent in retail trade.

restrictions (DART) per 100 full-time equivalent employees.[7] While the injury case rates were self-reported by the employers, OSHA has rigorous standards on record-keeping: falsifying records could result in a criminal fine of $10,000 or up to 6 months in jail, or both.

After collecting data on injury case rates, OSHA selected the DART case rates to be used as the targeting thresholds for different industries.[8] OSHA prioritized establishments for inspection if the DART case rates exceeded the corresponding targeting threshold. The thresholds were selected based on the anticipated number of inspections that OSHA would be able to conduct in the next cycle and the distribution of the DART case rates of the surveyed establishments. These thresholds were updated annually. The inspections were conducted during the SST inspection cycle, which started from around one year and a half after the initial collection of case rates and lasted for around one year. Table 1 shows the starting and closing dates of the SST plan from 2004-2011.[9] For example, ODI 2003 collected the injury case rates in 2002, which were used to design SST plan 2004. The inspections of SST plan 2004 were

[7] Starting from 2002, the number of cases with days away from work (DAFWII) per 100 employees is also collected in ODI.

[8] The SST plan had different thresholds targeting establishments in manufacturing, nursing and long-term care, and other industries. Starting from 2004, DAFWII case rate is added as an additional factor used to select the target list. This study focuses on the DART threshold as about 90 percent of establishments on the target list have DART case rates above the SST threshold of DART.

[9] The OSHA Data Initiative (ODI) has been suspended since 2011 and the SST plan since 2014.

conducted from April 2004 to Aug 2005. Thirty-five states participated in the SST plan, and non-participating states had their own state plans on occupational safety and health.[10]

This study focuses on inspections among nursing facilities, which were first included in the SST plan in 1999, removed from 2000-2003 and added back since 2004. Figure 1 shows the DART thresholds that the SST plan used to target nursing facilities and the average DART case rates of facilities surveyed by ODI from 2004 to 2011. About 10 percent of the nursing facilities have DART case rates above the SST threshold. The inspections conducted in nursing facilities focus on the general OSHA standards as well as the specific safety and health hazards in the health service sector. These hazards include musculoskeletal disorders related to patient or resident handling, workplace violence, blood-borne pathogens, tuberculosis, and slips, trips and falls as defined by OSHA guidelines (OSHA, 2015).

3. Methodology

The main empirical objective of this paper is to estimate the causal effect of inspections on workplace safety, healthcare quality, and worker productivity in nursing facilities. The effect is defined by the following equation:

$$\tau_{ijt} = Y_{ijt+1}(S_{ijt} = 1) - Y_{ijt+1}(S_{ijt} = 0) \quad (1)$$

Y_{ijt+1} indicates the outcomes of nursing facility i in state j in year $t+1$; S_{ijt} indicates whether the nursing facility receives an inspection in year t. The effect of an inspection is defined as the

[10] The states with their own plans are not covered by most of the federal OSHA programs. To obtain approval from OSHA for its own state plan, a state must go through extensive procedures. The majority of the state plans were initially approved in the 1970s to 1980s.

difference between the outcome when the facility with an inspection and without an inspection. Since $Y_{ijt+1}(S_{ijt} = 1)$ and $Y_{ijt+1}(S_{ijt} = 0)$ could not be observed at the same time, this paper uses a fuzzy regression discontinuity design to identify τ_{ijt}.[11]

The identification exploits the design of OSHA's Site-Specific Targeting (SST) plan. The key feature of the SST plan is that it increases the likelihood of inspections right at the SST threshold:

$$\lim_{X_{ijt}\downarrow 0} E[S_{ijt}|X_{ijt}] > \lim_{X_{ijt}\uparrow 0} E[S_{ijt}|X_{ijt}] \quad (1)$$

The running variable X_{ijt} is defined as $DART_{ijt} - SST_t$, the difference between the DART case rate and the corresponding SST threshold. The likelihood of inspections among establishments with DART case rates above the SST threshold is higher than the likelihood among those right below the threshold. Using this discontinuous increase in inspections, the effect of inspections, τ_{ijt}, is given by the following estimand:

$$\tau_{ijt} = \frac{\lim_{X_{ijt}\downarrow 0} E[Y_{ijt}|X_{ijt}] - \lim_{X_{ijt}\uparrow 0} E[Y_{ijt}|X_{ijt}]}{\lim_{X_{ijt}\downarrow 0} E[S_{ijt}|X_{ijt}] - \lim_{X_{ijt}\uparrow 0} E[S_{ijt}|X_{ijt}]} \quad (2)$$

The denominator measures the discontinuous change in inspections at the SST threshold. The numerator measures the discontinuous change in the outcomes of nursing facilities at the SST threshold. The fuzzy regression discontinuity design gives the local average treatment effect (LATE) of inspections among the compliers with injury rates close to the SST threshold. While the estimate may not be generalized to nursing facilities with lower injury rates, the effect of inspections among these relatively dangerous facilities is of the most policy interest.

[11] Lee and Lemieux (2010) provides a review the regression discontinuity design.

The effect of inspections is estimated using the following three models. First, the first stage model estimates denominator of equation 2, which reflects the discontinuous increase in inspections among facilities with DART case rate at the SST threshold. Specifically, the first stage model is as follows:

$$S_{ijt} = \alpha_0 + \alpha_1 T_{ijt} + \alpha_2 f(X_{ijt}) + \alpha_3 T_{ijt} f(X_{ijt}) + \alpha_4 Z_{ijt} + \delta_j + \theta_t + \epsilon_{ijt} \quad (3)$$

The outcome S_{ijt} indicates whether nursing facility i in state j has any inspection during the SST plan corresponding to year t, which starts from the middle of the second year after collecting the injury case rates and lasts for around one year. T_{ijt} is defined as $1\{X_{ijt} \geq 0\}$, which is an indicator of whether the DART case rate of facility i in year t is above the corresponding SST threshold. $f(X_{ijt})$ and $g(X_{ijt})$ are flexible controls of the DART case rates, allowed to be different above and below the SST threshold. Z_{ijt} includes control variables on the total number of beds, whether the facility is in a chain, whether it is for-profit, share of patients paid through Medicaid, and the acuity index of patients' physical conditions. The model also includes state and year fixed effects, δ_j and θ_t.

The coefficient of T_{ijt}, α_1, identifies the effect of the SST plan on the likelihood of inspections among facilities at the SST threshold. By design, α_1 should be positive and significant.

Second, the reduced form model estimates the numerator of equation 2, which reflects the discontinuous change in the outcomes of nursing facilities at the SST threshold.

$$Y_{ijt+1} = \beta_0 + \beta_1 T_{ijt} + \beta_2 f(X_{ijt}) + \beta_3 T_{ijt} g(X_{ijt}) + \beta_4 Z_{ijt} + \delta_j + \theta_t + \epsilon_{ijt} \quad (4)$$

Y_{ijt+1} indicates the outcomes of facility i one year after the corresponding SST inspection cycle. The right hand side of the model is the same as the first stage. The coefficient of T_{ijt}, γ_1, identifies the differential change in the outcomes of nursing facilities at the SST threshold.

Lastly, the causal effect of inspections on the outcomes of nursing facilities is modeled using the following equation:

$$Y_{ijt+1} = \gamma_0 + \gamma_1 S_{ijt} + \gamma_2 f(X_{ijt}) + \gamma_3 T_{ijt} g(X_{ijt}) + \gamma_4 Z_{ijt} + \delta_j + \theta_t + \epsilon_{ijt} \quad (5)$$

The endogenous variable of inspection, S_{ijt}, is instrumented with T_{ijt}, the indicator of DART case rate above the SST threshold. The two-stage estimate of γ_1 gives the causal effect of OSHA inspections on the outcomes among the compliers with injury case rate at the SST threshold.

The model is estimated using local linear regressions, first suggested by Hahn, Todd, and van der Klaauw (2001). Specifically, the optimal bandwidth is selected following the method suggested by Calonico, Cattaneo, and Titiunik (2014) and the standard errors presented are bias-corrected robust standard errors clustered at the facility level.[12] The advantage of estimating the model non-parametrically is that there is no need to specify functional forms of $f(X_{ijt})$ and $g(X_{ijt})$. If the functional forms are specified incorrectly, the estimates are likely to be biased. Additionally, the estimates avoid using the commonly used high-order polynomials as proxies of the functional forms, which leads to poor inferences (Gelman and Imbens, 2014).

4. Data

4.1. Data Sources

[12] Calonico, Cattaneo, and Titiunik (2014) finds using a data-driven, asymptotically mean-squared error (MSE) optimal bandwidth and including a robust bias-correction term in the estimated confidence interval offer good finite-sample performance compared with commonly used approach that assumes away the bias of the estimator.

This study uses establishment-level data linking the injury case rates to OSHA inspection records and a census of nursing facilities from CMS. The data on injury case rates are from the OSHA Data Initiative (ODI). ODI includes annual surveys covering about 80,000 establishments from 1996 to 2011. The establishments are sampled annually from those with 40 or more employees[13] in 46 states.[14] ODI contains basic information on the establishments, including name, street address, and industry. The injury case rates reported in ODI include Total Case Rate (TCR) and Days Away, Restricted, and Transfer (DART) case rate. Nursing and personal care facilities are oversampled in ODI. From 1996 to 2011, 143,771 surveys were conducted on 23,917 nursing facilities.

To determine to the effect of the SST plan on the frequency of inspections, the injury case rates from ODI are matched to the inspection records from OSHA Integrated Management Information System (IMIS). IMIS contains records on all closed OSHA inspections since 1970. The data include establishment name and street address, which are used to match the inspection records to the injury case rates from ODI. The data also include the inspection type, open and close dates of the inspection, which are used to determine whether an inspection is conducted under the SST plan and which year of the SST plan. Additionally, the data provide a detailed list on the violations and the amount of penalty associated with each violation, if applicable.

To estimate the effect of inspections on the quality of care in nursing facilities, the ODI/IMIS data are further matched to a census of the nursing facilities complied by the Centers

[13] In 1996 and 1997, only establishments with 60 or more employees were included.

[14] States did not participate in ODI in 2011 include Alaska, Oregon, South Carolina, Washington, Wyoming, and District of Columbia. These states have their own state plans

for Medicare & Medicaid Services (CMS), based on establishment name and address. The records on nursing facilities are derived from the Online Survey, Certification and Reporting (OSCAR) database. OSCAR is the most comprehensive dataset at the facility level, containing information on operational characteristics, resident health outcomes, staffing level, and records on deficiency citations issued by state health agencies. The data are collected annually on average, with a standard window between 9 to 15 months (Harrington et al., 2015). The data include about 16,000 Medicare and/or Medicaid certificated nursing facilities each year, representing more than 95 percent of long-term care facilities in the US. The empirical analysis uses data from 2006 to 2011, since from July 2012 the system is transited to Certification and Survey Provider Enhanced Reports (CASPER) and some of the health outcomes are no longer available.

The quality of care in nursing facilities is approximated by the quality of assistance with activities of daily living (ADLs) and the resident health outcomes. Two measures on the quality of assistance with ADLs are considered. The first is the number of deficiency citations on providing appropriate ADL care, which reflects the results of annual onsite evaluations conducted by state health agencies. State health agencies conduct annual examinations on whether a facility is in compliance with more than 100 federal requirements regarding quality of care, quality of life, and facility practices. The deficiencies regarding ADL care includes violations of the following standards: “activities of daily living do not decline unless unavoidable”, “resident is given treatment to improve abilities”, and “activities of daily living care is provided for dependent residents”. The second set of measures of assistance with ADLs is the fraction of residents receiving full assistance from staff to transfer, use toilets, and eat. These variables are reported by staff and reflect the actual level of assistance provided to the residents

during a seven-day period (CMS, 2008). The dataset also includes ADL acuity index, which measures the residents' physical functioning level.

In addition to the quality of ADL care, a set of health outcomes are used to measure healthcare quality. Contractures reflect a restriction of full passive range of motion of any joint due to deformity, disuse, and pain; catheter use reflects any indwelling or external catheter, pressure sores and skin rashes reflect the skin integrity of residents, unplanned weight changes reflect any unplanned weight gain or loss of 5 percent in one month or 10 percent over six months; and behavioral symptoms include a wide range of behaviors that are harmful to the residents themselves or disruptive in the environment, such as wandering, verbally or physically abusive, socially inappropriate or disruptive, and resistive to care. These health outcomes are selected as they are commonly used to measure quality of care in nursing homes and also sensitive to the quality of nursing care.

4.2. Analysis Sample

The main analysis sample includes nursing facilities surveyed by ODI from 2002 to 2007. These facilities are covered by the SST plan from mid-2004 to mid-2010 and the outcomes are from 2006 to 2011, measured around one year after the end of the SST inspection cycle. Facilities with fewer than 10 residents are excluded. The main analysis sample includes 11,832 nursing facility-year observations.

Table 2 shows the descriptive statistics of the analysis sample as well as the subsamples with DART case rates right above and below the SST threshold. The nursing facilities have on average 10.57 occupational injuries per 100 full-time equivalent employees (TCR) annually, among which 6.87 cases involves days away from work, job transfers or restrictions (DART). While only 4.1 percent of the whole analysis sample is inspected, the SST plan dramatically

increases the inspection likelihood among facilities with DART above the threshold. Among facilities with DART from 0 to 5 cases above the SST threshold, 39 percent of them receive an inspection during the SST inspection cycle, much higher than the 3 percent among those within 5 units below the threshold.

To examine the effect of inspections on workplace safety, a subsample is constructed consisting of facilities with multiple surveys from ODI. The injury case rates are only observed if a facility is surveyed in ODI. As ODI selected a different sample of establishments each year, facilities were typically surveyed several times, but not every year. Among the main analysis sample, included are those with another survey four year after the initial survey, which is around one year after the SST inspection cycle. This sample includes 4,707 facility-year observations.

The key assumption of the regression discontinuity design is that firms right above and below the SST threshold should have similar observed and unobserved characteristics. The assumption is likely to be valid based on the design of the SST plan. OSHA selected and announced the SST threshold after collecting the data on injury case rates and updated the threshold every year, making it difficult to precisely predict the threshold ex-ante. Thus, nursing facilities should have limited ability to manipulate their injury case rates and avoid inspections. Figure 2 shows the distribution of nursing facilities by DART case rates relative to the SST threshold using the main analysis sample. Consistent with the assumption, the distribution shows no discontinuous change across the SST threshold. The density test suggested by McCrary (2008) gives a log density of 0.026 and standard error of 0.101, confirming that the distribution is smooth across the SST threshold.

5. Results

5.1. The SST plan and Inspections

The SST plan prioritized nursing facilities for inspection if the DART case rates exceeded the SST threshold. To examine the magnitude of the SST plan graphically, Figure 3, Panel A plots the frequency of inspections by DART case rate relative to the SST threshold. The inspections include any programmed inspections conducted during the corresponding SST inspection cycle. The lines in Figure 3 show the fitted values using local linear smoothing. Visually, the frequency of inspections shows a sizable increase at the SST threshold: 39 percent of the nursing facilities with DART case rates within 1 unit above the threshold receive an inspection during the SST inspection cycle, and only 6 percent of those within 1 unit below are inspected.

The first-stage results, estimated using equation 3, are presented in Table 3, Panel A. Column 2 reports the mean of the dependent variable right at the SST threshold. Column 3 reports the estimates of the discontinuity at the SST threshold using local linear regressions, with state and year fixed effects and controls the number of beds, whether in a chain, whether for profit, share of Medicaid patients, and ADL acuity index. The SST plan increases the frequency of inspections by 32 percentage points, representing a five hundred percent increase compared with the average frequency of inspections among facilities right below the threshold. The SST plan also increases the frequency of detecting any violations of safety standards by 24 percentage points, suggesting many OSHA inspections identify some violations of safety standards.

While the SST plan creates a discontinuous increase in the frequency of inspections, using the discontinuity to identify the causal effect of inspections requires facilities near the SST threshold to be similar. To test this assumption, first, the frequency of inspections in the year right before and after the SST inspection cycle is examined. While the SST plan dramatically

increases the frequency of inspections at the SST threshold during the SST plan inspection cycle, any differential changes at the threshold before or after the inspection cycle will bias the estimates on the causal effect of inspections. The graphical evidence is presented in Figure 3, Panel C and D. Consistent with the assumption, the frequency of inspections in the year before and after the SST inspection cycle is relatively low and shows no discontinuous change at the SST threshold. The estimated differences are small and statistically insignificant (Table 3, Panel B). Second, the differences of the operational characteristics at the SST threshold are examined, including the number of beds, the number of residents, whether the facility is in a chain, whether it is for-profit, share of Medicaid patients, and ADL acuity index. The tests reveal no selection of nursing facilities as these observed characteristics show small and insignificant changes at the threshold (Table 3, Panel C).

5.2. Inspections and Workplace Injuries

Clearly, nursing facilities with DART case rates above the SST threshold are similar to those below the threshold, except for the higher frequency of inspections. To examine the effect of OSHA inspections on injury case rates, Figure 4 plots the injury case rates one year after the SST inspection cycle by DART case rate relative to SST threshold. While both DART and TCR one year after the SST plan are positively correlated with DART in the initial survey year, both measures show a discontinuous decrease right at the SST threshold. As nursing facilities with DART above the SST threshold are more likely to be inspected, the discontinuous decrease in DART and TCR at the SST threshold suggests that inspections are associated with lower injury case rates.

Table 4, column 3 presents the reduced form estimates, which measure the size of the discontinuity at the SST threshold. The estimates from the reduced form equation 4 suggest that

facilities right above the SST threshold have 1.30 fewer injuries involving days away from work, job transfers or restrictions and 2.06 fewer injuries of any type per 100 employees. Column 4 presents the two-stage estimates of equation 5 using the SST threshold as an instrument of the inspection variable. After an inspection, DART decreases by 5.6 cases per 100 employers, representing a 38 percent decrease among nursing facilities close to the SST threshold. TCR case rate decreases by 7.3 cases per 100 employees (38 percent). Both DART and TCR decrease by a similar proportion, suggesting that inspections reduce both mild injuries with no losses of workdays and relatively severe injuries with losses of workdays. Overall, the results imply that OSHA inspections are effective in reducing workplace injuries among relatively dangerous nursing facilities.[15]

5.3. Inspections and Healthcare Quality

Inspections are found to be associated with fewer workplace injuries, but they may negatively affect the quality of healthcare in nursing facilities. As a highly labor-intensive industry, labor accounts for 74 percent of the total costs in nursing facilities (Gertler and Waldman, 1992). After inspections, nurses may devote extra effort to complying with OSHA regulations and preventing injuries, resulting in less effort on patient care and lower healthcare quality. Two sets of indicators on healthcare quality are examined: the quality of assistance with activities of daily living (ADLs) and the health outcomes of the residents.

Assistance with ADLs is particularly relevant in studying the association between nurse injuries and service quality. ADL care is the most fundamental care provided in nursing

[15] The results are consistent with Li and Singleton (2018) and Johnson, Levine and Toffel (2017), which find the SST plan led to lower workplace injury case rates.

facilities, with 86 percent of the residents in need of assistance with at least one ADL.[16] ADL care also constitutes the major job responsibility of nursing aides, accounting for 63 percent of the staff in nursing facilities.[17] More importantly, assistance with ADLs involves extensive patient handling and moving activities, which contributes to nearly half of the workplace injuries in health care facilities (Gomaa et al., 2015). Thus, after inspections, facilities may adjust the practice of ADL care, as part of the effort to reduce workplace injuries.

The first indicator examined on ADL care is any deficiency citations on providing appropriate ADL care. Figure 5, Panel A plots the frequency of citations on providing ADL care by DART relative to the SST threshold. Facilities with DART case rates above the SST threshold, which are more likely to have an OSHA inspection, show an around 5 percentage point discontinuous increase on citations regarding ADL care. The estimates are shown in Table 5, Panel A. After inspections, the facilities are 18.3 percentage points more likely to have a citation on ADL care, representing a more than two hundred percent increase, compared with the mean frequency of 9 percent at the SST threshold. The results are consistent with the assumption that after inspections nurses reduce risky activities involving moving and handling patients to avoid workplace injuries.

As a placebo test, the numbers of deficiency citations on keeping clinical records and patient transfer or discharge are examined. First, the most common citation received by nursing facilities is on "keep accurate, complete, and organized clinical records on each resident that

[16] Author's calculation based on 13,507 residents from 2004 National Nursing Home Survey.

[17] Author's calculation based on nursing facilities in the Online Survey, Certification and Reporting (OSCAR) database from 2006-2011.

meet professional standards". Complying with the requirement on record-keeping is unlikely to cause workplace injuries and should not be affected by effort to reduce injuries. As expected, the number of citations on recording-keeping at the SST threshold show a small and insignificant change (Table 5, Panel A). Second, the number of deficiencies regarding patient transfer and discharge[18] shows little changes after inspections. After inspections, facilities may have incentives to select easier residents, which could lead to more citations regarding patient transfer and discharge. The lack of any significant changes in the frequency of citations on patient transfer and discharge at the SST threshold suggests that facilities are unlikely to selectively transfer or discharge residents after inspections.

The second set of indicators on assistance with ADLs is the fraction of residents receiving full ADL assistance. As shown in Figure 5, panel B-D, after inspections, the fraction of residents receiving full assistance from staff to transfer, to use toilets, and to eat decreases discontinuously at SST threshold. Since the SST plan leads to no differential change in the number of residents across the threshold, the results suggest that nurses provide ADL assistance to fewer residents after inspections. Specifically, one year after an inspection, the fraction of residents receiving full assistant from staff to transfer decreases by 4.4 percentage points (19 percent), the fraction with full assistance to use toilets decreases by 6.3 percentage points (23 percent), and the fraction with full assistance to eat decreases by 4.2 percentage points (29 percent) (Table 5, Panel B). The reduction in assistance on ADLs is likely from staff providing

[18] The deficiencies on patient transfer and discharge includes "no transfer or discharge without adequate reasons"; "providing timely notification and written records on transfer or discharge"; and "preparing each resident for a safe and easy discharge or transfer".

less assistance rather than residents in need of more ADL care as the ADL acuity index shows no change at the SST threshold (Table 2). Overall, after inspections, facilities provide less assistance on ADLs.

In addition to ADL care, the quality of care is measured by the health outcomes of the residents, which are widely used to approximate the quality of care in studies on nursing home quality (Matsudaira, 2014; Lin, 2014; Bowblis and McHone, 2013). Figure 6 plots the resident health outcomes by DART case rates relative to the SST threshold. The inspections are associated with a 3.2 percentage point increase in the fraction of residents with skin rashes and an 10.1 percentage point increase in behavioral symptoms, representing a 30 percent increase (Table 6). The effect of inspections on the fraction of residents with contractures, catheter, pressure sores, and unplanned significant weight change is small and insignificant. Panel B of Table 6 presented the estimates on the health outcomes of patients at admission, which shows small and insignificant change at the SST threshold. In summary, inspections are associated with worse quality of care, evidenced by lower quality of ADL care and worse health outcomes among residents.

5.4. Inspections and Patient Composition

After inspections, the quality of ADL assistance worsens, which is likely due to the effort to preventing injuries from moving and handling patients. Alternatively, nursing facilities may select patients in need of less ADL assistance after inspections, which will lead to fewer nurse injuries from moving patients and fewer residents receiving ADL care.

Little evidence supports the hypothesis of patient selection. First, nursing facilities can only discharge or transfer residents in a limited number of scenarios, including the closure of a facility, lack of payment for the service, improvement of health that nursing home care is not

necessary or deterioration of health that nursing home care is not sufficient. Thus, it is difficult for the nursing facilities to manipulate the composition of the residents, especially in the short run. Additionally, the outcomes in the previous analysis are measured one year after the SST plan while the average length of stay in nursing facilities is 835 days and the median is 463 days.[19] Within one year, the limited turnover of residents suggests the results are unlikely to be driven by patient selection. The health outcomes at admission and ADL acuity index also show no change after inspections (Table 2 and Table 6, Panel A), implying that facilities are unlikely to select patients in better health conditions after the inspections.

Lastly, the share of residents financed through Medicaid shows no change after inspections. Medicaid residents generally have lower reimbursement rates and worse health outcomes (Cohen and Spector, 1996). If facilities actively select patients in need of less intensive care after inspections, they are likely to selectively transfer or discharge the less profitable Medicaid residents. No change in the share of Medicaid residents appears at SST threshold after inspections (Table 2), which also suggests the worse quality of ADL care are unlikely to be driven by patient selection.

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5.5. Inspections and Worker Productivity

Thus far, the results show that OSHA inspections reduce workplace injuries, but negatively affect healthcare quality, likely to be a result that nurses devote more effort to preventing injuries after inspections. With more effort devoted to preventing injuries, nurse

[19] Author's calculation based on 12,973 residents surveyed in 2004 National Nursing Home Survey.

productivity may also decrease. Nurse productivity is approximated by both the quality-adjusted care per unit of labor input (Sojourner et al., 2015). After inspections, the quality of care decreases with no change in number of residents, the remaining question is the effect of inspections on labor input.

The labor input is measured by the number of nursing hours per patient day among four types of nurses. In nursing facilities, about 63 percent of the staff are nursing aides, who typically assist residents with daily activities such as eating, dressing, and using the bathroom; 22 percent are licensed practical nurses, who provide direct care to residents under the supervision of registered nurses; 10 percent are registered nurses, who assess the health conditions of the residents and create personal care plans for each person; and 5 percent are nurses with administrative duties, who coordinate with staff but do not provide direct care for the residents.

Figure 7 plots the staffing level by DART case rate relative to the SST threshold one year after the SST plan. The nursing hours per patient day among nurses interacting directly with residents, including nursing aides, licensed practical nurses, and registered nurses, are similar across the SST threshold, as presented in Panel A-C. Table 7 shows the estimates on the effect of inspections on nursing hours per patient day. Inspections lead to small and insignificant changes in hours of nursing aides, licensed practical nurses and registered nurses. Thus, the less assistance with ADLs after inspections are unlikely to be a result of fewer nurses providing direct care for residents.

An exception is the hours of nurses with administrative duties, which increase after inspections, shown in Figure 7, Panel D. The hours of nurses with administrative duties increase by 0.1 hours per patient day, representing a 37 percent increase compared with the 0.28 hours per patient day on average. As nurses with administrative duties implement nursing policies and

oversee other nurses, the results may suggest that facilities devote more effort to management and coordination of care and after inspections.

Overall, inspections have a small and insignificant impact on nursing hours devoted directly on patients but lead to worse quality of care, particularly on ADLs. The results reveal two potential mechanisms. After inspections, nursing facilities provide full assistance on ADLs to fewer patients to reduce injuries related to moving and handling patients. Additionally, nursing facilities might devote more labor to each task involving patient handling and moving to reduce injuries, as the availability of more caregivers are related with fewer musculoskeletal injuries (Trinkoff et al., 2003). The two mechanisms together contribute to a decrease in quality of ADL care and number of nurse injuries with no change in total nursing hours.

Considering nurse productivity approximated by quality-adjusted output per labor hour, while there is no change in labor hour and the number of residents, the worse quality of care after inspections suggests lower nurse productivity after inspections. The results highlight the unintended effect of safety regulations on worker productivity: effort to improve workplace safety leads to lower worker productivity in nursing facilities.

5.6. Non-Participating States

The empirical evidence suggests the SST plan increased the inspections at the targeting threshold, and nurses provide less ADL care and residents show worse health outcomes. The SST plan covers nursing facilities in thirty-five states and the rest of the states have their own state plans on occupational safety and health. These state plans often include programs enforcing the safety and health standards in nursing facilities, but do not use the SST threshold to select the target list. Thus, the resident outcomes should show no discontinuity at the SST threshold in facilities in states with their own OHSA plans. Table 8 presents the results on ten states that were

not included in the SST plan but were surveyed in ODI. As expected, the quality of ADL care and the resident outcomes show small and insignificant changes at the SST threshold.

6. Conclusion

This study measures the effect of OSHA inspections on the workplace, healthcare quality, and worker productivity in nursing facilities. The inspections reduce workplace injuries among the nurses, but negatively affect the quality of care, evidenced by worse quality of ADL care and more behavioral symptoms among the residents. The worse ADL care quality may be a result that nurses avoid injuries by reducing patient handling and moving activities. The results also imply a decrease in worker productivity after inspections.

The results have implications on the policies regarding occupational safety. First, the results suggest establishment-level information could be useful in targeting inspections, given OSHA's limited resources on inspections. OSHA conducts around 80,000 inspections annually, which only covers less than 1% of the workplaces in the country. The inspections through the SST plan, which targeted establishments with high injury rates, are found to be effective in reducing workplace injuries. Starting from 2017, OSHA launched its Injury Tracking Application (ITA), which strengthened the requirement on injury reporting. The program requires the majority of the establishments with 250 or more employees, and establishments with 20-249 employees that are classified in certain industries with historically high injury rates to submit information on workplace injuries to OSHA, which might facilitate OSHA to targeting inspections more effectively.

Second, this study highlights the unintended effect of safety enforcement on product quality and worker productivity. While the enforcement of safety standards may contribute to the

reduction of injuries and the associated costs, the increasing costs on product quality and worker productivity are largely overlooked. As an industry with one of the highest workplace injury rates, the working conditions nursing facilities are extensively regulated. Since 2005, eleven states have initiated legislations on promoting safe patient handling to address the high rate of musculoskeletal injuries in health care sector (Weinmeyer, 2016), which might potentially have an unintended impact on the welfare of the patients.

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Table 1. The Starting and Closing Dates of the Site-Specific Targeting (SST) Plan, 2004-2011

Injury Rates	OSHA Data Initiative (ODI)	SST Plan	Starting Date	Closing Date
2002	2003	2004	4/19/2004	8/5/2005
2003	2004	2005	8/5/2005	6/12/2006
2004	2005	2006	6/12/2006	5/14/2007
2005	2006	2007	5/14/2007	5/19/2008
2006	2007	2008	5/19/2008	7/20/2009
2007	2008	2009	7/20/2009	10/22/2010
2008	2009	2010	10/22/2010	9/9/2011
2009	2010	2011	9/9/2011	1/4/2013

Table 2. Summary Statistics on Injury Rates, Inspections, and Operational Characteristics of Nursing Facilities

	Whole Sample	[-5, 0)	[0, 5]
Injury Case Rate			
TCR	10.566	15.653	21.334
	(7.409)	(5.377)	(6.065)
DART	6.868	11.815	16.683
	(5.197)	(1.695)	(1.695)
Inspections			
Inspections	0.041	0.030	0.393
	(0.199)	(0.170)	(0.489)
Violations	0.026	0.018	0.263
	(0.159)	(0.133)	(0.441)
Facilities			
Total Beds	120.606	122.026	116.137
	(64.761)	(61.206)	(60.778)
Total Residents	101.228	104.370	99.922
	(59.832)	(55.925)	(58.318)
In a Chain	0.494	0.543	0.569
	(0.500)	(0.498)	(0.496)
For-Profit	0.721	0.695	0.720
	(0.449)	(0.461)	(0.449)
Medicaid Patients (%)	62.620	62.966	63.666
	(17.791)	(15.517)	(15.131)
ADL Index	10.091	10.134	10.118
	(1.311)	(1.192)	(1.164)
N	11,832	1,839	643

Note: The sample is derived from the OSHA Data Initiative (ODI), OSHA Integrated Management Information System (IMIS), and the Online Survey, Certification, and Reporting (OSCAR) database from the Centers for Medicare & Medicaid Services (CMS).

Table 3. The Effect of the SST Plan on Inspections, Violations, and Facility Characteristics

	Mean at SST	Local Linear
Panel A		
Inspections	0.055	0.322***
		(0.052)
Violations	0.043	0.242***
		(0.040)
Panel B		
Inspections Year Before	0.063	0.002
		(0.039)
Inspections Year After	0.047	0.019
		(0.030)
Panel C		
Total Bed	119.178	-6.084
		(6.714)
Total Residents	103.878	-5.462
		(6.414)
In a Chain	0.545	0.057
		(0.058)
For-Profit	0.735	-0.012
		(0.050)
Medicaid Patients (%)	0.637	-0.004
		(0.018)
ADL Acuity Index	10.153	-0.122
		(0.118)
N		11,832

Note: The sample is derived from the OSHA Data Initiative (ODI), OSHA Integrated Management Information System (IMIS), and the Online Survey, Certification, and Reporting (OSCAR) database from the Centers for Medicare & Medicaid Services (CMS).The analysis covers the SST plan 2004-2009. Each cell in column 2 shows the mean of the outcome at the SST threshold. Each cell in column 3 shows an estimate from local linear models with a triangular kernel, the optimal bandwidth and robust standard errors clustered at the facility level, suggested by Calonico, Cattaneo, and Titiunik (2014). All the models include controls on the number of beds, whether in a chain, whether for profit, share of Medicaid patients, ADL acuity index, and state and year fixed effects.

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

Table 4. The Effect of Inspections on Injury Case Rates One Year After the SST Plan

	Mean at SST	Reduced Form	Two-Stage
DART	14.452	-1.298*	-5.599*
		(0.821)	(2.968)
TCR	19.348	-2.061*	-7.298*
		(1.150)	(4.355)
N	4,707	4,707	4,707

Note: The sample is derived from the OSHA Data Initiative (ODI), OSHA Integrated Management Information System (IMIS), and the Online Survey, Certification, and Reporting (OSCAR) database from the Centers for Medicare & Medicaid Services (CMS).The analysis covers the SST plan 2004-2009 and the sample includes facilities received another survey around one year after the SST inspection cycle. Each cell in column 2 shows the mean of the outcome at the SST threshold. Each cell in column 3 and 4 shows an estimate from local linear models with a triangular kernel, the optimal bandwidth and robust standard errors clustered at the facility level, suggested by Calonico, Cattaneo, and Titiunik (2014). All the models include controls on the number of beds, whether in a chain, whether for profit, share of Medicaid patients, ADL acuity index, and state and year fixed effects.

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

Table 5. The Effect of Inspections on ADL Care

	Mean at SST	Reduced Form	Two-Stage
Panel A: Deficiency			
ADL Care	0.087	0.061	0.183
		(0.040)	(0.112)
Transfer	0.028	0.014	0.035
		(0.023)	(0.062)
Record	0.167	-0.022	-0.071
		(0.042)	(0.123)
Panel B: ADL Care			
Transfer	0.233	-0.016	-0.044
		(0.012)	(0.031)
Use Toilet	0.274	-0.027*	-0.063*
		(0.016)	(0.039)
Eat	0.143	-0.014*	-0.042*
		(0.008)	(0.023)
N			11,832

Note: The sample is derived from the OSHA Data Initiative (ODI), OSHA Integrated Management Information System (IMIS), and the Online Survey, Certification, and Reporting (OSCAR) database from the Centers for Medicare & Medicaid Services (CMS).The analysis covers the SST plan 2004-2009. The outcomes in Panel A are number of deficiency citations on each standard. The outcomes in Panel B are the fraction of residents receiving full assistance on ADLs. Each cell in column 2 shows the mean of the outcome at the SST threshold. Each cell in column 3 and 4 shows an estimate from local linear models with a triangular kernel, the optimal bandwidth and robust standard errors clustered at the facility level, suggested by Calonico, Cattaneo, and Titiunik (2014). All the models include controls on the number of beds, whether in a chain, whether for profit, share of Medicaid patients, ADL acuity index, and state and year fixed effects.

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

Table 6. The Effect of Inspections on Resident Health Outcomes

	Mean at SST	Reduced Form	Two-Stage
Panel A: One Year after SST Plan			
Contracture	0.290	-0.013	-0.019
		(0.023)	(0.059)
Catheter Use	0.064	0.004	0.010
		(0.006)	(0.013)
Pressure Sores	0.069	-0.007	-0.003
		(0.006)	(0.011)
Skin Rashes	0.053	0.015*	0.032*
		(0.008)	(0.022)
Weight Change	0.078	-0.001	0.007
		(0.008)	(0.019)
Behavioral Symptoms	0.273	0.035*	0.101*
		(0.022)	(0.059)
Panel B: At Admission			
Catheter Use	0.046	0.001	0.001
		(0.004)	(0.011)
Contracture	0.178	0.026	0.067
		(0.021)	(0.055)
Pressure Sores	0.035	-0.001	-0.002
		(0.003)	(0.007)
N			11,832

Note: The sample is derived from the OSHA Data Initiative (ODI), OSHA Integrated Management Information System (IMIS), and the Online Survey, Certification, and Reporting (OSCAR) database from the Centers for Medicare & Medicaid Services (CMS).The analysis covers the SST plan 2004-2009. Each cell in column 2 shows the mean of the outcome at the SST threshold. Each cell in column 3 and 4 shows an estimate from local linear models with a triangular kernel, the optimal bandwidth and robust standard errors clustered at the facility level, suggested by Calonico, Cattaneo, and Titiunik (2014). All the models include controls on the number of beds, whether in a chain, whether for profit, share of Medicaid patients, ADL acuity index, and state and year fixed effects.

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

Table 7. The Effect of Inspections on Nursing Hours per Patient Day

	Mean at SST	Reduced Form	Two-Stage
Nursing Aides	3.417	0.061	0.161
		(0.092)	(0.283)
Licensed Practical Nurses	1.202	-0.025	0.002
		(0.052)	(0.114)
Registered Nurses	0.541	-0.017	-0.080
		(0.035)	(0.082)
Nurses with Administrative Duties	0.275	0.036	0.102*
		(0.026)	(0.060)
N			11,832

Note: The sample is derived from the OSHA Data Initiative (ODI), OSHA Integrated Management Information System (IMIS), and the Online Survey, Certification, and Reporting (OSCAR) database from the Centers for Medicare & Medicaid Services (CMS).The analysis covers the SST plan 2004-2009. Each cell in column 2 shows the mean of the outcome at the SST threshold. Each cell in column 3 and 4 shows an estimate from local linear models with a triangular kernel, the optimal bandwidth and robust standard errors clustered at the facility level, suggested by Calonico, Cattaneo, and Titiunik (2014). All the models include controls on the number of beds, the number of residents, whether in a chain, whether for profit, share of Medicaid patients, ADL acuity index, and state and year fixed effects.

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

Table 8. The Effect of Inspections on Healthcare Quality, Non-Participating States

	Mean at SST	Reduced Form
Panel A: ADL		
ADL Care	0.037	-0.020
		(0.062)
Transfer	0.223	0.001
		(0.021)
Use Toilet	0.252	0.016
		(0.023)
Eat	0.148	0.006
		(0.016)
Panel B: Health Outcomes		
Contracture	0.235	0.042
		(0.035)
Catheter Use	0.062	-0.007
		(0.008)
Pressure Sores	0.062	0.004
		(0.009)
Skin Rashes	0.070	-0.004
		(0.014)
Weight Change	0.073	0.020
		(0.014)
Behavioral Symptoms	0.313	-0.018
		(0.032)
N		2,845

Note: The sample is derived from the OSHA Data Initiative (ODI), OSHA Integrated Management Information System (IMIS), and the Online Survey, Certification, and Reporting (OSCAR) database from the Centers for Medicare & Medicaid Services (CMS).The analysis covers non-participating states from 2004 to 2009. Each cell in column 2 shows the mean of the outcome at the SST threshold. Each cell in column 3 shows an estimate from local linear models with a triangular kernel, the optimal bandwidth and robust standard errors clustered at the facility level, suggested by Calonico, Cattaneo, and Titiunik (2014). All the models include controls on the number of beds, whether in a chain, whether for profit, share of Medicaid patients, ADL acuity index, and state and year fixed effects.

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

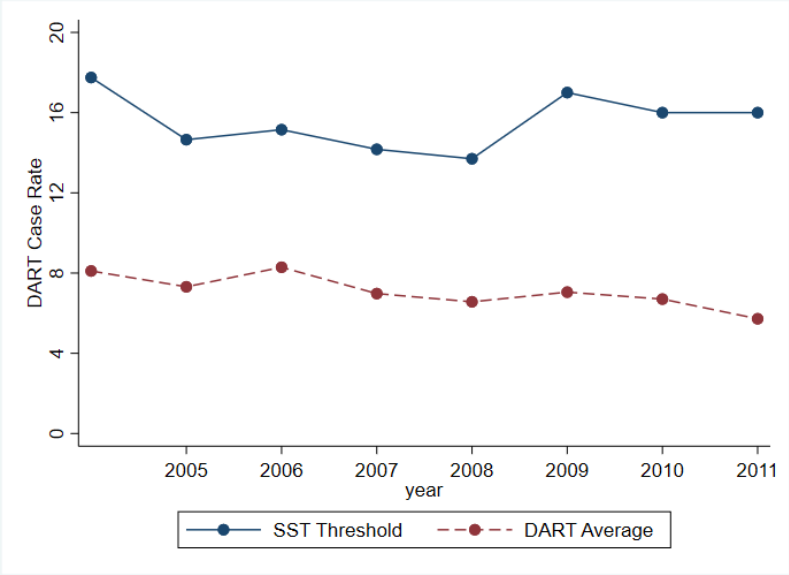


Figure 1. Days Away, Restricted, and Transfer (DART) Case Rate Threshold of Site-Specific Targeting (SST) Plan and Average DART Case Rate, Nursing Facilities 2004-2011

Notes: DART case rate is calculated as (number of cases involving days away from work, job transfers or restrictions * 200,000) / total employee hours worked, which gives the case rate per 100 full time equivalent employees.

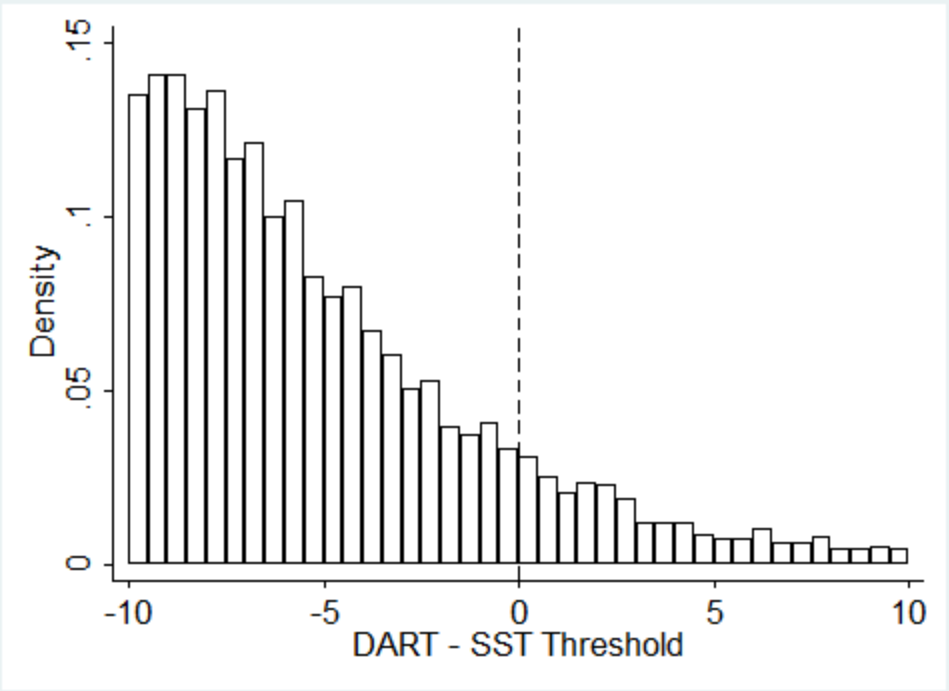
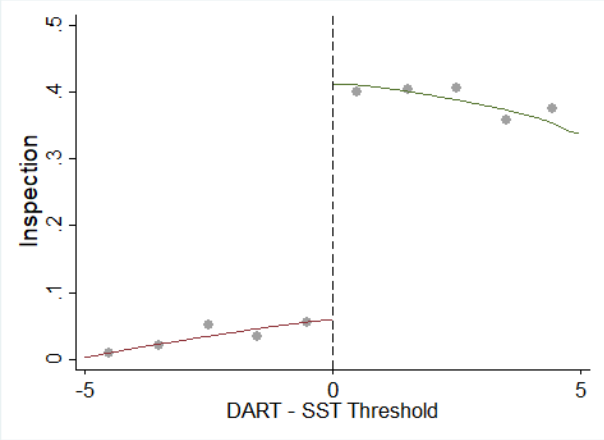


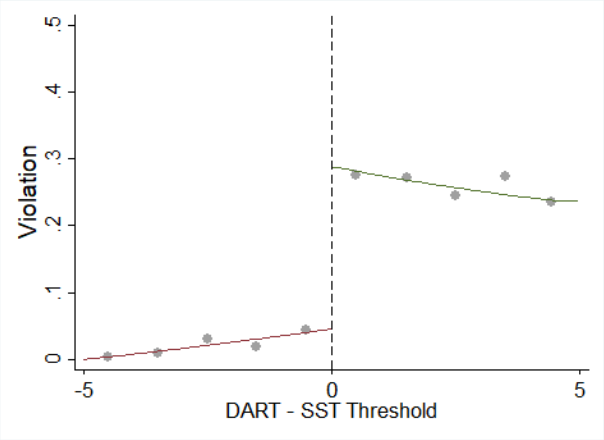
Figure 2. Distribution of Nursing Facilities by DART Case Rate Relative to the SST Threshold

Note: The sample is derived from OSHA Data Initiative (ODI) matched to OSHA's Integrated Management Information System (IMIS) and the Online Survey, Certification, and Reporting database (OSCAR) from the Centers for Medicare & Medicaid Services (CMS). N=6,827. McCrary's density test shows the difference of density at the threshold is small and insignificant (log density = 0.026, SE = 0.092).

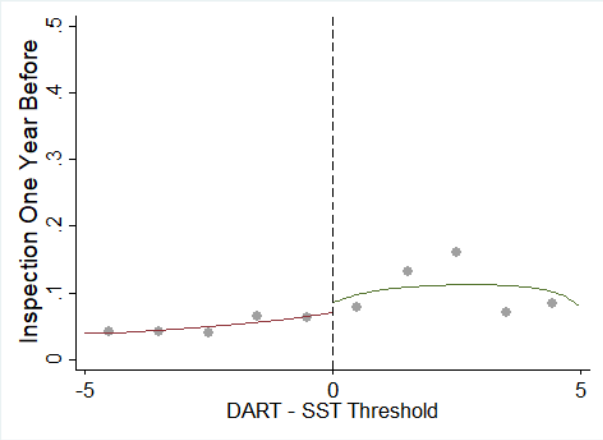
Panel A. Inspections



Panel B. Violations



Panel C. Inspections One Year before SST



Panel D. Inspections One Year after SST

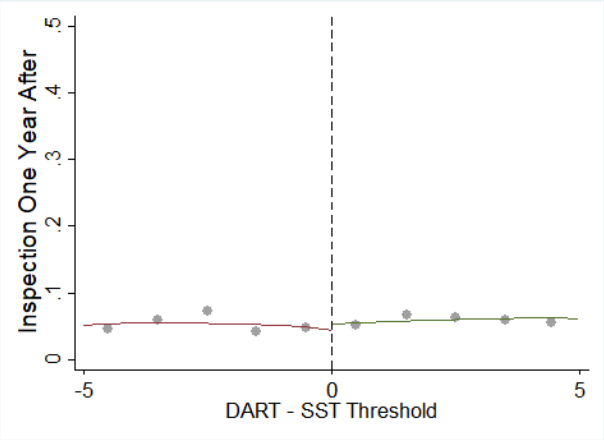
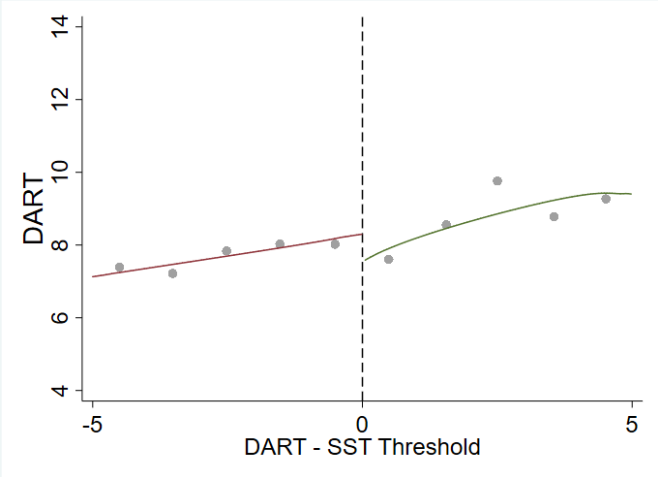


Figure 3. Frequency of Inspections and Violations by DART Case Rate Relative to the SST Threshold

Notes: The sample is derived from OSHA Data Initiative (ODI) matched to OSHA's Integrated Management Information System (IMIS) and the Online Survey, Certification, and Reporting database (OSCAR) from the Centers for Medicare & Medicaid Services (CMS). The graphs show the frequency of inspections and violations by (DART case rate– SST threshold). The markers denote the mean outcomes within intervals of one. The lines are fitted values from local linear regressions. N=2,482.

Panel A. DART Case Rate One Year after SST



Panel B. TCR One Year after SST

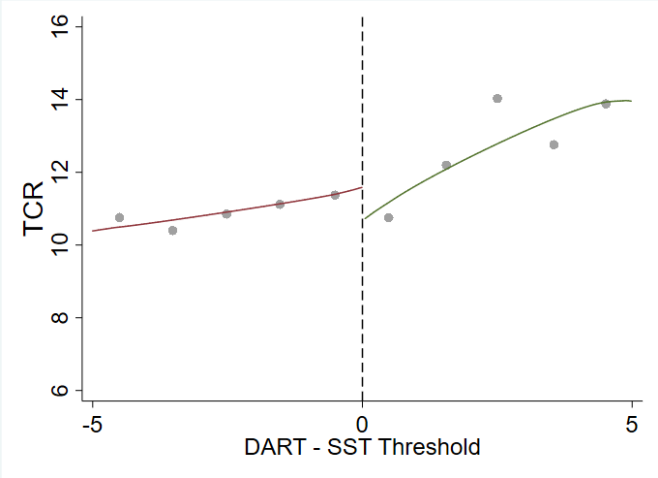


Figure 4. The Effect of the SST Plan on the Injury Case Rates One Year After

Note: The sample is derived from OSHA Data Initiative (ODI) matched to OSHA's Integrated Management Information System (IMIS) and the Online Survey, Certification, and Reporting database (OSCAR) from the Centers for Medicare & Medicaid Services (CMS). The sample includes nursing facilities with another ODI survey fours year after the initial survey. The outcomes represent injury rates around one year after the SST plan. DART is the number of cases involving days away from work, job restriction, or job transfer per 100 employees, and TCR is total case rate per 100 employees. The markers denote the mean outcomes within intervals of one. The lines are fitted values from local linear regressions. N=1,328.

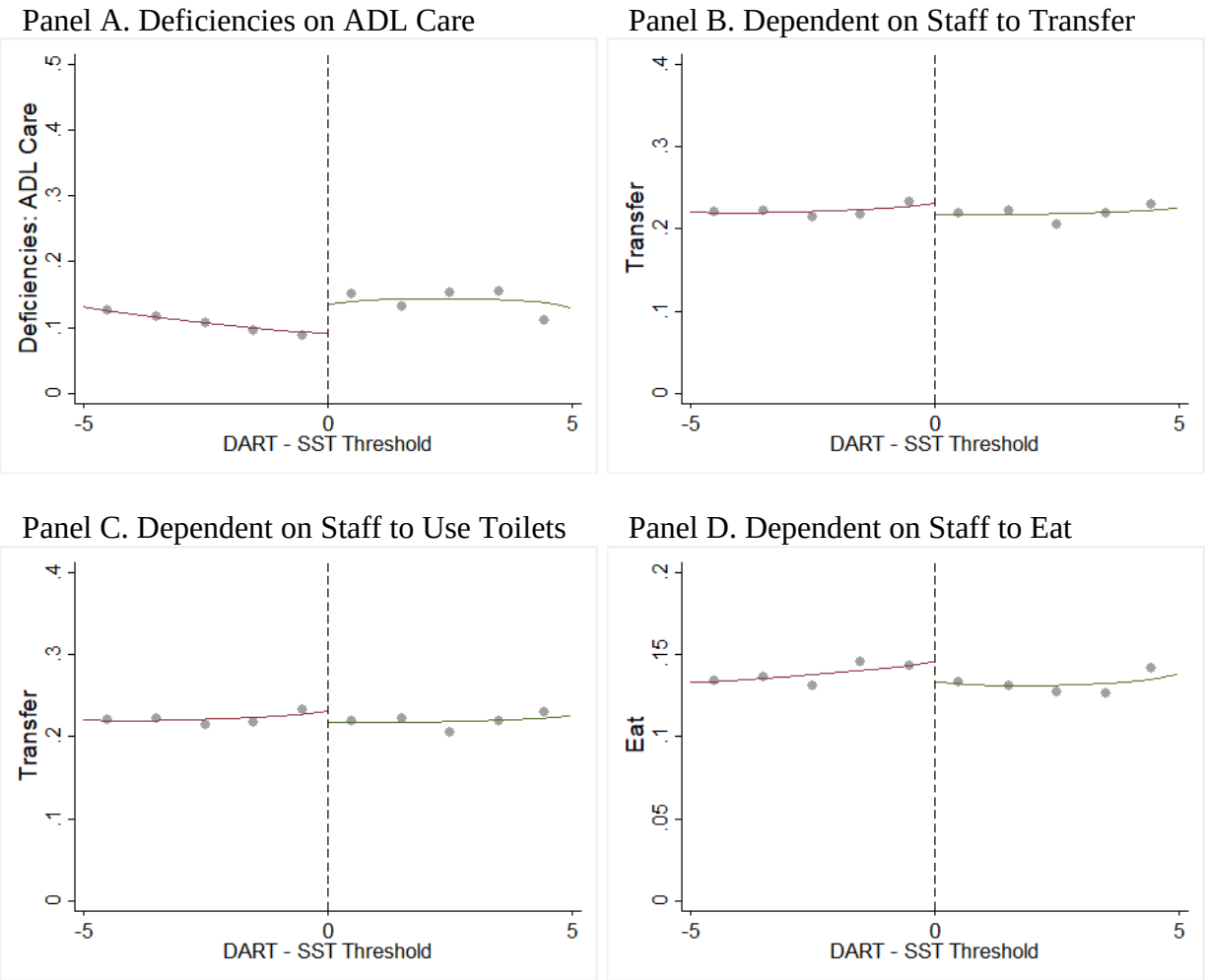


Figure 5. The Effect of the SST Plan on the Fraction of Residents Receiving Full Assistance from Staff with Activities of Daily Living (ADLs)

Note: The sample is derived from OSHA Data Initiative (ODI) matched to OSHA's Integrated Management Information System (IMIS) and the Online Survey, Certification, and Reporting database (OSCAR) from the Centers for Medicare & Medicaid Services (CMS). Outcomes are measured around one year after the SST plan. The dependency of ADLs is measured as the fraction of residents fully dependent on staff with ADLs. The markers denote the mean outcomes within intervals of one. The lines are fitted values from local linear regressions. N=2,482.

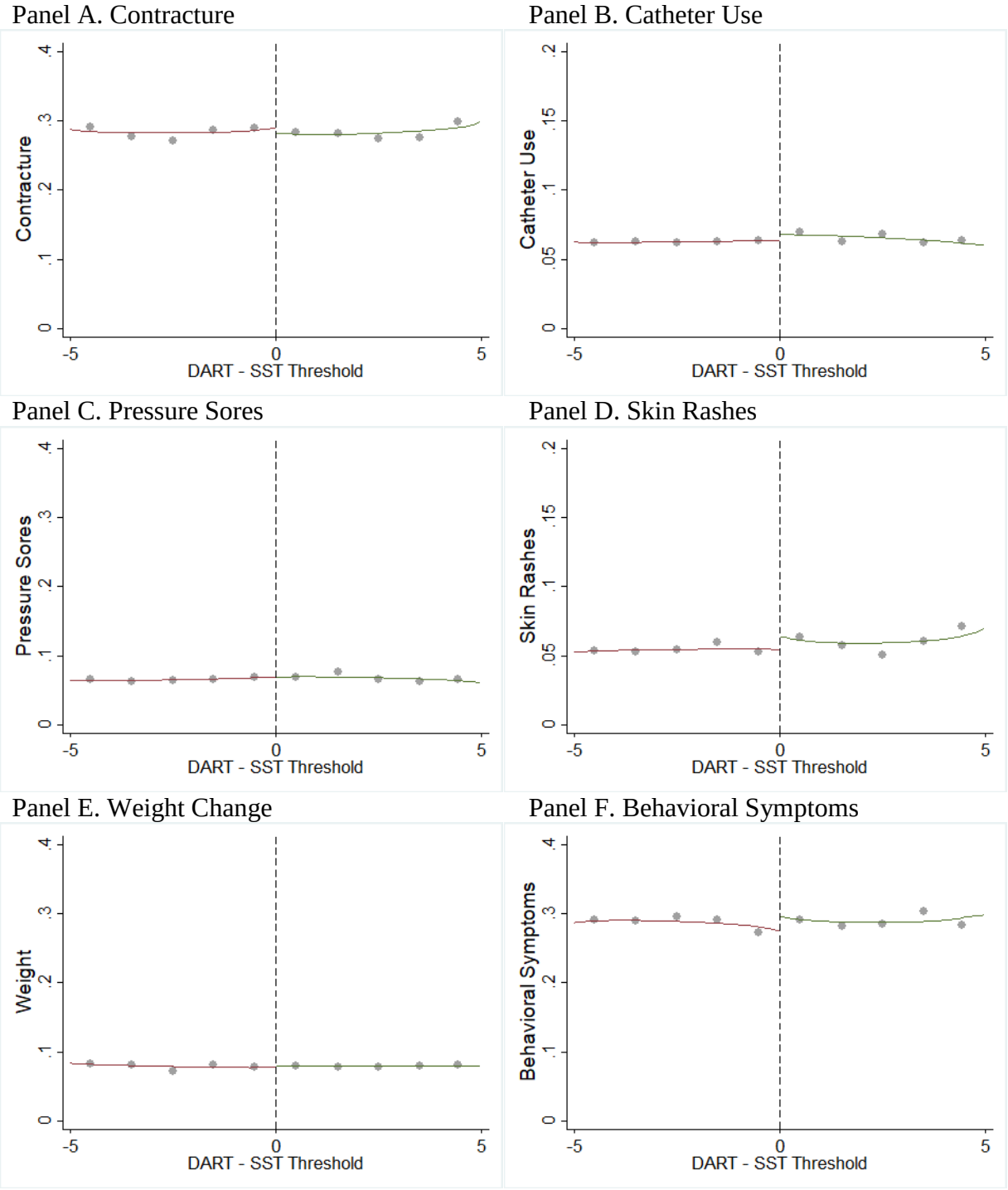


Figure 6. The Effect of the SST Plan on Resident Health Outcomes

Note: The sample is derived from OSHA Data Initiative (ODI) matched to OSHA's Integrated Management Information System (IMIS) and the Online Survey, Certification, and Reporting database (OSCAR) from the Centers for Medicare & Medicaid Services (CMS). The health

outcomes are measured as percent of residents with specific conditions, around one year after the SST plan. The markers denote the mean outcomes within intervals of one. The lines are fitted values from local linear regressions. N=2,482.

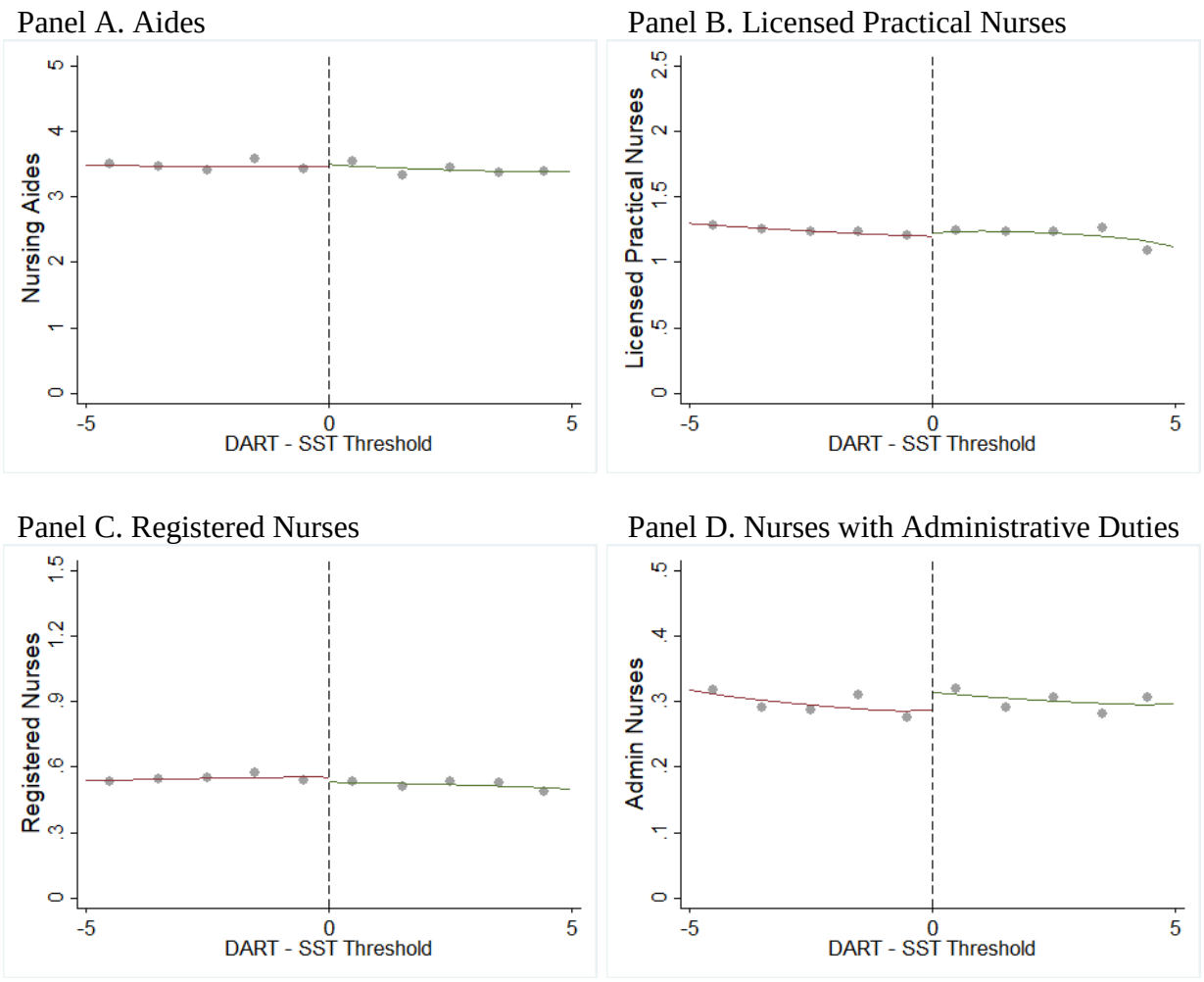


Figure 7. The Effect of the SST Plan on the Nursing Hours of Nursing Facilities

Note: The sample is derived from OSHA Data Initiative (ODI) matched to OSHA's Integrated Management Information System (IMIS) and the Online Survey, Certification, and Reporting database (OSCAR) from the Centers for Medicare & Medicaid Services (CMS). Staffing level is measured as nursing hours per patient day, around one year after the SST plan. The markers denote the mean outcomes within intervals of one. The lines are fitted values from local linear regressions. N=2,482.