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RESEARCH ARTICLE

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Association between nursing home staff turnover and infection control citations

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Abstract

Objective: To describe the association between nursing home staff turnover and the presence and scope of infection control citations.

Data Sources: Secondary data for all US nursing homes between March 31, 2017, through December 31, 2019 were obtained from Payroll-Based Journal (PBJ), Nursing Home Compare, and Long-Term Care: Facts on Care in the US (LTC Focus).

Study Design: We estimated the association between nurse turnover and the probability of an infection control citation and the scope of the citation while controlling for nursing home fixed effects. Our turnover measure is the percent of the facility's nursing staff hours that were provided by new staff (less than 60 days of experience in the last 180 days) during the 2 weeks prior to the health inspection. We calculated turnover for all staff together and separately for registered nurses, licensed practical nurses (LPNs), and certified nursing assistants.

Data Collection/Extraction Methods: We linked nursing homes standard inspection surveys to 650 million shifts from the PBJ data. We excluded any nursing home with incomplete or missing staffing data. Our final analytic sample included 12,550 nursing homes with 30,536 surveys.

Principal Findings: Staff turnover was associated with an increased likelihood of an infection control citation (average marginal effect [AME] = 0.12 percentage points [pp]; 95% confidence interval [CI]: 0.05, 0.18). LPN (AME = 0.06 pp; 95% CI: 0.01, 0.11) turnover was conditionally associated with an infection control citation. Conditional on having at least an isolated citation for infection control, staff turnover was positively associated with receiving a citation coded as a "pattern" (AME = 0.21 pp; 95% CI: 0.10, 0.32). Conditional of having at least a pattern citation, staff turnover was positively associated with receiving a widespread citation (AME = 0.21 pp; 95% CI: 0.10, 0.32).

Conclusions: Turnover was positively associated with the probability of an infection control citation. Staff turnover should be considered an important factor related to the spread of infections within nursing homes.

KEYWORDS
COVID19, employee turnover, health workforce, infection control, long-term care, nursing home

What is known on this topic

- Staff turnover in nursing homes is high.
- Infections are a common cause of morbidity among nursing home patients, particularly during the COVID-19 pandemic.
- Prior studies have not been able to examine the relationship between nursing turnover and infection control citations at the national level.

What this study adds

- We used recent data from 2016 to 2019 to precisely measure staff turnover immediately before a nursing home inspection survey.
- We found staff turnover was significantly associated with the presence of infection control citations.
- As the COVID-19 pandemic continues to exacerbate existing staffing concerns in the long-term care industry, policy makers and nursing home managers should consider reforms and strategies aimed at reducing nursing staff turnover.

1 | INTRODUCTION

An estimated 1.13–2.68 million infections occurred among nursing home residents in 2013.[1] Infections are a persistent cause for concern in nursing homes due to close community living conditions and high levels of chronic illness. Staff at nursing homes might act as a vector going room to room, resident to resident. Some staff work across multiple nursing homes, contributing to the spread of infections from facility to facility.[2,3] Without proper infection control practices such as washing hands, personal protective equipment, isolating infectious patients, infection surveillance, and reporting, the potential to spread an infection increases, putting vulnerable older adults at risk.

To ensure adequate infection control, the nursing home survey and certification process includes oversight of facility practices. To participate in Medicare and Medicaid, nursing homes are (re)certified through a survey process every 12–15 months. If a facility does not meet certain health standards set by the federal government, surveyors issue a deficiency citation, categorized into different areas, or F-tags. From 2017 to 2019, more than half of nursing homes had an infection control deficiency (F-tag 880): 41% of nursing homes had one citation for infection control, and 15% had two or more such citations.[4]

Although infection control had been a concern in nursing homes prior to the COVID-19 pandemic,[5] it has taken on a heightened importance due to its significant role as a tool to prevent and mitigate COVID-19 outbreaks among residents and staff. As of early September 2020, roughly 85% of nursing homes have reported a case of COVID-19 among residents or staff.[6] In September 2020, nursing home cases accounted for roughly 40% of COVID-19 deaths, ranging as high as 80% of the deaths in New Hampshire.[7] These numbers are likely an underestimate of the true national toll of COVID-19 in nursing homes due to a lack of uniform reporting by states. Many of the nursing homes with reported COVID-19 cases were cited with infection control violations in recent years.[8] From March to August 2020, the Centers for Medicare and Medicaid Services (CMS) has prioritized targeted infection control surveys to assess whether facilities were implementing proper practices to prevent the spread and transmission of COVID-19.[9,10] Additionally, as of January 2021, CMS outlined the criteria—which include multiple weeks with new COVID-19 cases and low staffing—that trigger a focused infection control survey.[11]

Previous outbreaks of norovirus, influenza, and clostridioides difficile have highlighted staffing issues in the long-term care industry.[5,12,13] For decades, nursing homes have experienced persistently high staff turnover.[14,15] Estimates of annual nursing home staff turnover exceed 100% for all nursing levels: 140.7% among registered nurses (RNs), 114.1% among licensed practical nurses (LPNs), and 129% among certified nursing assistants (CNAs).[16] Beginning in 2016, CMS required nursing homes to develop an infection prevention and control program.[17] Infection control programs require time-consuming and intensive processes, such as infection surveillance, tracking antibiotic use, and educating and monitoring staff.[18] They require the entire staff to be aware of the proper reporting of infections and to implement infection control processes. Frequent turnover in staffing and leadership may create additional opportunities for lapses in infection control practices due to lack of training, unfamiliarity with residents, or feeling rushed and cutting corners.

Early literature examining the relationship between nurse turnover and quality has been limited to samples from a few states and found mixed results.[19–24] Recent studies have incorporated more states and years but have similar limitations to the early research. Using data from 12 states, one study found a relationship between LPN turnover and ADL decline.[25] In a study focused on Florida nursing homes from 2002 to 2009, researchers found a positive relationship between LPN turnover and the rehospitalization rate.[26] Using 2004 survey data from 1151 nursing homes, researchers found CNA and LPN turnover was related to more quality deficiencies.[27] Using 2005 to 2011 data from California nursing homes, researchers found that nurse turnover is causally related to quality deficiencies.[28]

Only two studies have specifically examined the relationship between staffing and infection control. Zimmerman[20] found higher

RN turnover was associated with higher probability of infections in nursing home residents but did not measure other types of staffing turnover. Castle et al.[29] found lower staffing levels were associated with higher probability of infection control citations. To date, due to the lack of national data on staffing turnover, no studies have been able to quantify at a national level whether RN, LPN, and CNA staffing turnover are related to infection control citations. Our study takes advantage of the rich shift-level staffing data collected by CMS from 2016 to 2019 to fill this gap in the literature.

Based on prior literature[20,29] and a conceptual framework developed by Castle and Engberg,[30] we propose staffing, organizational (e.g., ownership), and market (e.g., location) characteristics will be associated with infection control violations. Staffing encompasses both staffing levels and staffing turnover. Under this conceptual framework, increased staffing turnover can negatively impact the quality of care through a number of pathways: (1) disrupting the continuity of care; (2) increasing the presence of inexperienced staff; (3) lowering the standard of care; (4) causing psychological distress for residents; (5) diverting resources from direct caregiving to recruiting, hiring, and training new staff; and (6) increasing the workload for remaining staff.[30] Because infection control standards take time to maintain, they may not be prioritized among other duties staff face when they face workforce shortages due to turnover. When additional staff are eventually hired, they will need to be trained and develop experience with procedures specific to the facility. It may take time for them to fully and consistently adhere to the infection control protocols. Monitoring and feedback of infection control protocols are essential to the process. Nursing homes face difficulties in maintaining monitoring processes when staffing levels are low and turnover is high. Additionally, staff must be aware of which residents are at higher risk of infection and which residents may have an infection: this resident familiarity is likely to be lower among newer staff. Qualitative research on infection prevention in nursing homes suggests that there is tension between infection control procedures and resident care needs such as quality of life.[31,32] Further, due to multiple roles for staff in the nursing home setting, particularly in nursing homes without a dedicated infection control specialist, when there are staff turnover,[18,32] remaining staff need to shift focus to make sure they take care of residents' basic needs.

2 | METHODS

2.1 | Data sources and sample

Data were obtained from the Payroll-Based Journal (PBJ), Nursing Home Compare, and Long-Term Care: Facts in the US (LTC Focus). As part of the Patient Protection and Affordable Care Act, CMS mandates nursing homes to report direct care staffing information based on payroll and other auditable data beginning in July 2016, known as the PBJ. We used data of 650 million nurse shifts from the PBJ between October 1, 2016, and December 31, 2019. We used summary data from Nursing Home Compare that compiles nursing home standard surveys for the last three survey cycles, from March 31, 2017, through December 31, 2019. We linked the health survey data to the PBJ on survey date. There were 25 surveys dropped for being complaint surveys. We used LTC Focus data[33] from 2017 for nursing home characteristics based on previous literature.[20,29,30]

2.2 | Variables

2.2.1 | Dependent variable

We measured our primary outcome in two ways: The first is as a binary variable indicating whether the facility was cited for an infection control violation. These citations are currently recorded with an F-tag of 880 but were also recorded with an F-tag of 441 prior to November 2017. The second is as an ordinal variable, because some infection control violations may be more serious than others in the number of residents impacted. The health inspector reports the scope of each violation to be one of the following: isolated (affecting a single or very limited number of residents), pattern (affecting more than a very limited number of residents), or widespread (affecting a large portion or all residents). Correspondingly, when treating infection control violations as an ordinal variable we assigned the lowest value to no citation and the highest value to citations with widespread scope.

Although citations can also vary according to severity, it is important to note that the non-immediate nature of infection control citations allows little variation. Surveyors categorized the majority (98%) of infection control citations in our sample as the second level of severity (out of four total), having "No actual harm with potential for more than minimum harm that is not immediate jeopardy." We, therefore, do not distinguish the severity of citations in our analysis.

2.2.2 | Independent variables

Our key independent variable was nursing staff turnover measured using daily shift-level data from the PBJ system. Prior work used these new data to construct annualized measures of turnover but has not studied its association with infection control.[16] Because our outcome measures were health inspection deficiencies, we constructed a measure of turnover for the period immediately prior to each health inspection survey by analyzing staffing records in the shift-level PBJ data for the 6 months (180 days) preceding each health inspection. In constructing our measure, we first identified "new" nursing staff members as those with less than 60 days of experience working at the facility prior to the health inspection. Importantly, these new staff were likely hired as the result of staff turnover in the months prior to the health inspection. Our turnover measure was therefore the percent of the facility's nursing staff hours that were provided by these new staff during the 2 weeks prior to the health inspection. In other words, we measured turnover

using the percentage (from 0% to 100%) of care that was provided by new staff in the period leading up to a health inspection. We further discuss the PBJ data, our algorithm to identify new staff, and explore alternative measures in Appendix B.

We also included staffing levels (RN/CNA/LPN) measured as minutes per resident day in the 2 weeks prior to the health survey calculated from the PBJ system.

2.3 | Facility characteristics

To describe our sample, we used organizational characteristics from LTC Focus and NH Compare. These included number of beds, ownership (for-profit, non-profit, government), chain membership, percent of resident-days paid for by Medicaid, occupancy percent, and whether it was located in an urban county.

2.4 | Data analysis

We calculated descriptive analyses for nursing home characteristics using means with standard deviations for continuous variables and proportions for categorical variables. Our unit of analysis is the standard nursing home survey. We additionally calculated descriptive statistics about the turnover measures' correlation with each other and the relationship between them at each time point, which are provided in the Appendix.

We performed separate regression analyses for each outcome. First, we leveraged the longitudinal nature of the data and estimated the relationship between turnover and infection control citations using a linear probability model with nursing home fixed effects. The inclusion of facility fixed effects enforces that the coefficients on our time-varying variables—staffing turnover and staffing levels—are identified based only on within-facility changes over time. For ease of interpretation, we multiplied coefficients by 100 so that they may be interpreted as percentage point (pp) changes. For example, the coefficient on turnover corresponds to the pp change in the probability of receiving an infection control violation associated with a 1 pp increase in turnover. Likewise, the coefficient on staffing levels corresponds to the pp change in the probability of receiving an infection control violation associated with a 1-min increase in care per resident day.

We also estimated an ordered logit model that allows us to assess the relationship between the scope of the citation and staffing turnover. As with the linear probability model, we included nursing home fixed effects in the ordered logit model to enforce that the coefficients on staffing turnover and staffing levels are identified from within-facility changes over time. For ease of interpretability and comparability with the linear probability model, we presented our estimates from our ordered logit model using average marginal effects (AMEs), which correspond approximately to the average increase in the probability of the outcome associated with a one-unit increase in the independent variable. This approximation becomes exact as one considers infinitesimally small changes in the independent variable,

TABLE 1 Characteristics of nursing homes in analytic sample

Panel A: Nursing home characteristics	**Nursing homes $N = 12{,}550$**
Part of chain, No. (%)	7524 (60.0)
Ownership, No. (%)	
For-profit	8919 (71.1)
Non-profit	2868 (22.8)
Government	763 (6.1)
Total number of beds, mean (SD)	110.6 (59.7)
Percent residents whose primary payer is Medicaid, Mean (SD)	60.5 (21.9)
Occupancy percent, mean (SD)	81.3 (14.1)
Census region, No. (%)	
Northeast	2143 (17.0)
Midwest	4076 (32.5)
South	4500 (35.9)
West	1831 (14.6)
Urban, No. (%)	8993 (71.7)
Surveys per nursing home	
Number of nursing homes with two surveys	7114 (56.7)
Number of nursing homes with three surveys	5436 (43.3)
Panel B: Nursing home health inspection survey characteristics	**Nursing home health inspection survey $N = 30{,}536$**
Any infection control citation, No. (%)	11,787 (38.6)
Scope, No. (%)	
Isolated	6106 (20.0)
Pattern	4116 (13.5)
Widespread	1565 (5.1)
Nursing home staffing turnover[a] preceding survey	
Combined nurse turnover (%), mean (SD)	22.6 (13.0)
RN turnover (%), mean (SD)	23.9 (19.9)
LPN turnover (%), mean (SD)	21.1 (17.4)
CNA turnover (%), mean (SD)	23.1 (14.4)
Nursing home staffing levels preceding survey	
Combined staff minutes per resident day, mean (SD)	204.8 (41.0)
RN minutes per resident day, mean (SD)	24.6 (16.6)
LPN minutes per resident day, mean (SD)	48.6 (17.2)
CNA minutes per resident day, mean (SD)	131.6 (29.3)

Abbreviations: CNA, certified nursing assistant; LPN, licensed practical nurse; No., number; RN, registered nurse; SD, standard deviation.

[a]The turnover rate is defined as the percent of staff hours in the 2 weeks prior to the inspection survey that was provided by new staff.

and for ease of exposition, we treat the AME as corresponding exactly to the effect of a 1 pp increase in the measure.

To further aid with the interpretability of our ordered logit estimates, when presenting the AMEs for the likelihood of receiving a specific scope of violation, we presented AMEs conditional on receiving at least a violation with one level of scope lower. For example, we presented the AME on the likelihood of receiving a "pattern" citation given that the facility was already going to receive at least an "isolated" citation. Likewise, we presented the AME on the likelihood of receiving a "widespread" citation given that the facility was already going to receive at least a "pattern" citation. Intuitively, this presentation of estimates focuses attention on facilities for whom the effect is most relevant. In Appendix Section C, we further explain the mechanics of the calculation of the conditional AME.

We estimated both our linear probability model and our ordered logit twice using two sets of independent variables: (1) using a combined staff turnover measure consisting of RNs, LPNs, and CNAs, and (2) using individual RN, LPN, and CNA turnover measures to distinguish the impact in each type of nursing staff. We clustered all standard errors at the nursing home level.

2.5 | Sensitivity analyses

We conducted several sensitivity analyses. First, we repeated our linear probability model specifications with interaction effects between the nursing turnover and staffing levels variables.[30] We created binary variables based on the median of each measure (e.g., above median nursing turnover and above median total nursing hours) and interacted them. Second, we repeated our main regression specifications using two alternate definitions of turnover to see how sensitive the results are to varying the definition of a "new" worker to less than 30 and 90 days of experience.

3 | RESULTS

3.1 | Nursing home characteristics

Table 1 presents characteristics of nursing homes (Panel A) and nursing home health inspection surveys (Panel B) in the analytic sample. The sample included 12,550 unique nursing homes and 30,536 nursing home inspection survey observations. The majority of observations in our sample correspond to facilities that are chain-owned (60%) and for-profit (71%). Average staff turnover was 23%, RN turnover was 24%, CNA turnover was 23%, and LPN turnover was 21%. Among surveys, 39% resulted in an infection control citation, of which 52% were isolated, 35% were pattern, and 13% were widespread. The majority of minutes are provided by CNAs (Mean: 131 min), followed by LPNs (Mean: 49 min) and then finally RNs (Mean: 24 min).

Figure 1 presents the distribution of turnover (Panel A) and nurse minutes per resident day (Panel B), overall and by type of nurse. As shown in Panel A, the turnover rates are right-skewed: the 95th percentile of nurse turnover is 44% and has a maximum at 100%. In Panel B, the distribution of nurse minutes per day is wide, with the 5th percentile of 143 min per resident day to the 95th percentile of

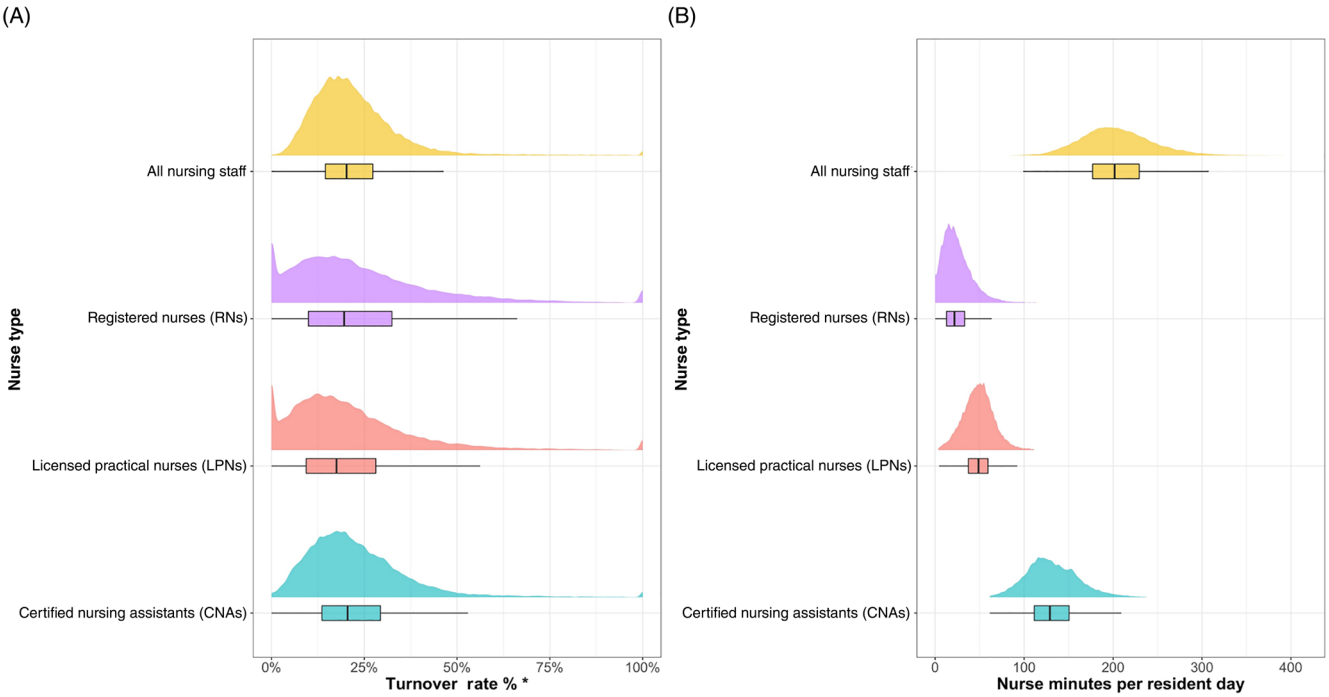

FIGURE 1 Distribution of nurse turnover and minutes per resident day by nurse type. (A) Turnover. (B) Minutes per resident day. *The turnover rate is defined as the percent of staff hours in the 2 weeks prior to the inspection survey that was provided by new staff [Color figure can be viewed at wileyonlinelibrary.com]

278 min per resident day. The distribution of RN minutes per resident day is narrow: the 5th percentile is 4 min per resident day and the 95th percentile is 56 min per resident day. Compared to the distribution of CNA minutes per resident day, the 5th percentile is 87 min per resident day and the 95th percentile is 184 min. Staffing turnover is weakly correlated over time, with correlation coefficients between 0.19 and 0.31 (Table S1).

3.2 | Predictors of infection control citations

In Figure 2, we present the results of a linear probability model using nursing home fixed effects, exploring the relationship between the probability of infection control citation and turnover. We also present the regression results in a table form in Table S2. In Panel A, we present the coefficients from the regression model. A 1 pp increase in staff turnover was associated with an AME of a 0.12 pp increase (95% CI: 0.05 pp, 0.18 pp) in the probability of receiving an infection control citation. A 1-min increase in staff minutes per resident day was associated with an AME of 0.05 pp lower probability (95% CI: −0.09 pp, −0.02 pp) of receiving an infection control citation. In Panel B, we present the coefficients from the regression model with each type of nurse separately. The coefficients on turnover were positive for RNs, LPNs, and CNAs; however, only the association with LPN turnover was statistically significant at the 95% level (AME = 0.06 pp; 95% CI: 0.01 pp,

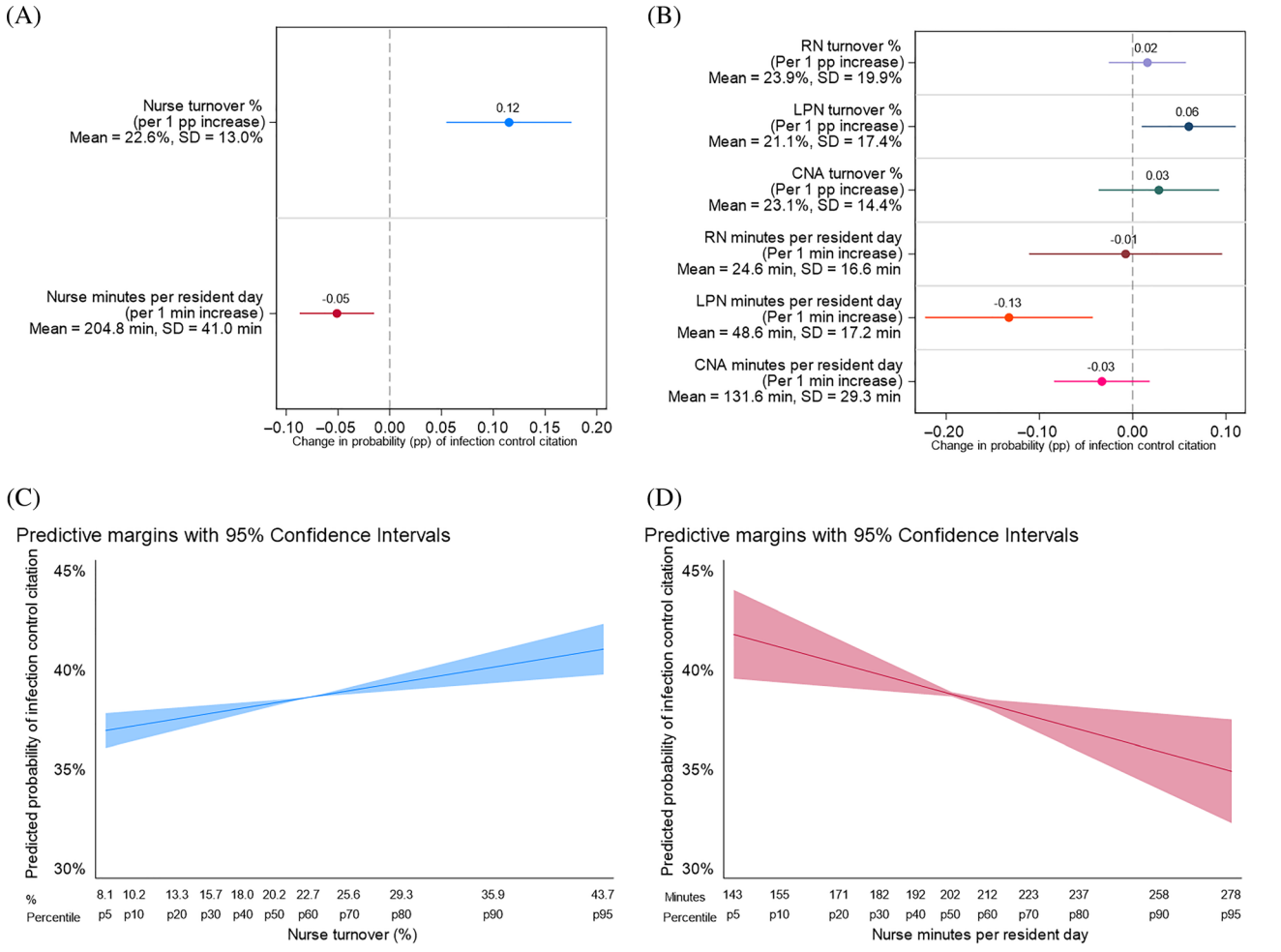

FIGURE 2 Average marginal effects of predictors on infection control citation. (A) Coefficients for nurse turnover and nurse minutes per day from regression model with facility fixed effects. (B) Coefficients for nurse turnover and nurse minutes per day from regression model with heterogeneous effects by nurse type and facility fixed effects. (C) Predictive margins for nurse turnover from regression model with facility fixed effects. (D) Predictive margins for nurse minutes per resident day from regression model with facility fixed effects. Percentage point (pp); minutes (min); registered nurse (RN), licensed practical nurse (LPN), certified nurse assistant (CNA); percentile (p); standard deviation (SD). Panels (A), (C), and (D) were created using linear regression models with facility-level fixed effects where the outcome was a dichotomous variable indicating presence or lack of infection control citation with independent variables nurse turnover and nurse minutes per resident day. Panel (B) was created using linear regression models with facility-level fixed effects where the outcome was a dichotomous variable indicating presence or lack of infection control citation with independent variables RN, LPN, CNA turnover and RN, LPN, CNA minutes per resident day. The number of observations in the regression was 30,536. The turnover rate is defined as the percent of staff hours in the 2 weeks prior to the inspection survey that was provided by new staff [Color figure can be viewed at wileyonlinelibrary.com]

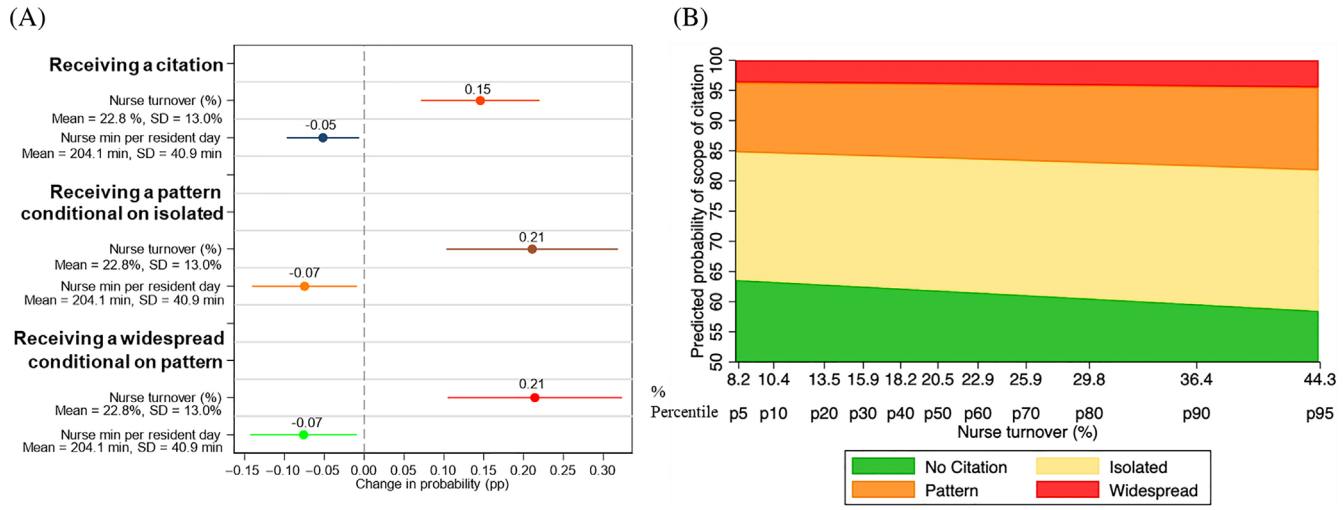

FIGURE 3 Average marginal effects for scope of infection control citation. (A) Average marginal effects for turnover and nurse minutes per resident day from an ordered logit model with facility fixed effects. (B) Predicted distribution of citation scope from an ordered logit model with facility fixed effects. Average marginal effect (AME); minute (min); percentage point (pp); percentile (p); standard deviation (SD). Panel (A) presents average marginal effects. Panel (B) visualizes the unconditional average marginal effects. Models used facility fixed effects with a four-level outcome of the scope of the citation (no citation, isolated, pattern, widespread), with nurse turnover and nurse minutes per resident day as independent variables. The number of observations used in the regression was 19,749. This is smaller than the sample used in the linear probability model because the inclusion of facility fixed effects in ordered logit model necessitates that the estimates are identified off of the facilities that experienced the change or where a citation was present (e.g., if a facility had no citations for the sample period they do not contribute information to the estimation). The turnover rate is defined as the percent of staff hours in the 2 weeks prior to the inspection survey that was provided by new staff [Color figure can be viewed at wileyonlinelibrary.com]

0.11 pp). Likewise, although all the coefficients on minutes per resident day were negative, only the coefficient on LPN minutes per resident day was statistically significant at the 95% level (AME = −0.13 pp; 95% CI: −0.22 pp, −0.04 pp). In Panels C and D, we present the margins estimates from the facility fixed effects model. Panel C indicates that moving from the 5th percentile of turnover to the 95th percentile of turnover increases the mean facility's likelihood of receiving an infection control violation from 36.9% to 41.0%, an increase of 4.1 pp. As a point of comparison, Panel D indicates that moving from the 5th percentile of nurse minutes per resident day to the 95th percentile of nurse minutes per resident day decreases the mean facility's likelihood of receiving an infection control violation from 41.8% to 34.8%, a decrease of 7 pp.

3.3 | Predictors of scope of infection control citation

In Figure 3, we present the results of an ordered logit model with nursing home fixed effects with the aim of exploring the relationship between staff turnover and the scope of infection control citation. The regression results are presented in a table form in Table S3. In Panel A, we present the AMEs for turnover and nurse minutes per resident day. Under this ordered logit model, we estimate the AME of a 1 pp increase in nursing staff turnover on the likelihood of receiving an infection control violation to be 0.15 pp (95% CI: 0.22 pp, 0.07 pp), which is similar to our linear probability estimate. Conditional on receiving at least an isolated citation, the AME of a 1 pp increase in nursing staff turnover on the probability of receiving a pattern citation is 0.21 pp (95% CI: 0.10 pp, 0.32 pp). As a point of comparison, we estimate the analogous conditional AME of an increase of one nurse minute per resident day to be −0.07 pp (95% CI: −0.14 pp, −0.01 pp). Conditional on receiving at least a pattern citation, the AME of a 1 pp increase in nurse turnover on receiving a widespread citation is 0.21 (95% CI: 0.10, 0.32). In comparison, we estimate the analogous conditional AME for one nurse minute per resident day to be −0.07 pp (95% CI: −0.14 pp, −0.01 pp). Panel B visualizes what the ordered logit estimates predict the distribution of citation scope would be at varying levels of turnover. The estimates suggest that moving the average facility from the 5th percentile of turnover to 95th percentile of turnover would increase the probability of isolated, pattern, and widespread citations from 21.1%, 11.6%, 3.6% to 23.2%, 13.7%, 4.5%, respectively. In Table S4, we present the AMEs for each type of nurse (RN/LPN/CNA) separately.

3.4 | Sensitivity analyses

We explored the potential for interactive effects between staff turnover and staff levels in Tables S5–S8. We find that the marginal effects of staff turnover and staff level interactions are positive and significant for low staff hours facilities (Table S5). Thus, facilities with both low staff hours and high turnover rates are more likely to have

infection control citations. However, this positive relationship between low staff and high turnover with infection control citations does not hold when separated into individual types (RN/LPN/CNA; Tables S6–S8).

In Tables S9–S12, we test the sensitivity of our turnover definition, varying the number of days we consider a staff "new" from the operating definition of less than 60 days to less than 30 days and less than 90 days within a 180-day period. Our results are consistent with those obtained using the main turnover definition. A 1 pp increase in nurse turnover is associated with receiving an infection control citation when using 30 days (AME = 0.15 pp; 95% CI: 0.05 pp, 0.24 pp; Table S9) and when using 90 days (AME = 0.07 pp; 95% CI: 0.02 pp, 0.12 pp; Table S10). Using an ordered logit model with the 30-day definition of turnover, we estimate the AME of a 1 pp increase in nursing turnover on the likelihood of receiving an infection control violation to be 0.20 pp (95% CI: 0.08 pp, 0.32 pp; Table S11). Conditional on receiving at least an isolated citation, the AME for 1 pp change in nursing turnover using the 30-day turnover measure on the probability of receiving a pattern citation is 0.29 pp (95% CI: 0.12 pp, 0.46 pp). Using an ordered logit model when using 90-day definition of turnover, we estimate the AME of a 1 pp change in nursing staff turnover on the likelihood of receiving an infection control violation to be 0.08 pp (95% CI: 0.03 pp, 0.14 pp; Table S12). Conditional on receiving at least an isolated citation, the AME of a 1 pp increase in nursing turnover using the 90-day turnover measure on the probability of receiving a pattern citation is 0.12 pp (95% CI: 0.04 pp, 0.21 pp).

4 | DISCUSSION

We found that nurse turnover was positively associated with receiving an infection control citation. We found that *holding staffing levels and facility fixed*, moving from one of the lowest turnover rates (5th percentile) to one of the highest turnover rates (95th percentile) increases the mean facility's likelihood of receiving an infection control violation from 36.9% to 41.0%, an increase of 4.1 pp. This effect is substantial, especially for a dimension of quality that is often not even measured, let alone considered. Compared to the equivalent estimates on the effect of total nurse staffing levels, a hallmark measure of facility quality, we found that moving from one of the lowest staffing levels (5th percentile) to one of the highest staffing levels (95th percentile) would decrease the mean facility's likelihood of receiving an infection control violation from 41.8% to 34.8%, a decrease of 7 pp. In other words, the effect of turnover appears to be comparable to the magnitude of the effect of staffing levels. Among nursing homes with an infection control citation, nurse turnover was positively associated with higher levels of scope infractions. However, the magnitude of the positive association between turnover and scope is modest, particularly because less than half of our sample received such a citation. Overall, our estimates were not sufficiently precise to confidently distinguish the relative importance of individual types of nurse turnover measures. Our estimates for RN, LPN, and CNA turnover are all positive with large standard errors. We recommend future research in this area when more years of PBJ data become available.

Prior studies have not been able to examine the relationship between nurse turnover and infection control citations at the national level. Zimmerman et al.[20] used data from Maryland nursing homes from 1992 to 1995 and found RN turnover was significantly related to nursing home infection rate, but they did not measure CNA or LPN turnover. Our study builds upon the work of Castle et al.[29] by using facility fixed effects to identify impacts of staffing within facility changes over time and including nurse turnover measures in addition to nurse levels to examine infection control citations. This study's findings were consistent with Castle et al.,[29] who found nurse levels were negatively associated with the probability of having an infection control citation.

Still, there are several strategies that both nursing homes and policy makers could employ that have the potential to reduce turnover. Increasing wages and benefits (e.g., sick leave) may improve retention and reduce turnover.[34–36] For example, wage pass-through programs have been successful in raising staff wages.[37–39] Second, these are positions where there is often no career ladder without additional years of training. Creating a career ladder within an organization, signaling staff investment may also reduce turnover.[40]

At the organizational level, culture is an important factor affecting staff retention, turnover, and quality of care.[41–46] Studies have found that lack of respect, inadequate management, and managers who did not solicit input when making a decision or empower staff to make decisions on their own were associated with higher levels of turnover.[42,44,45] Therefore, facilities aiming to reduce turnover should consider investing in leadership training or training a retention specialist, which has been found to improve the retention of CNAs.[47] An important caveat to leveraging changes to culture and leadership is that such changes may affect some staff types differently than others. For example, organizational culture with flexibility has been associated with lower LPN turnover; conversely, culture with emphasis on rigid internal rules has been associated with lower RN turnover.[43]

Although cases and deaths in the first wave of COVID-19 cases in nursing homes were not strongly associated with past infection control citations,[48] it is possible that other infectious disease outbreaks may be prevented or mitigated with proper infection control practices and consistent staff.[49] Reducing turnover has the potential to improve a facility's infection control practices, increase opportunities for continuing education in infection control, increase familiarity with residents, and maintain practices unrushed. In addition to reducing the probability of infection control citations, reducing staff turnover reduces the probability of other adverse events[24] such as hospitalizations,[26] pressure ulcers,[19,28] and facility contracted-catheters and physical restraints.[19,28] Even before the COVID-19 pandemic, nursing home staff faced high occupational stress caring for older adults with extensive health care needs like dementia.[50] Investing in strategies to reduce staff turnover has the potential to not only improve quality of life of nursing home residents but also staff.

4.1 | Limitations

There are some limitations to this study. First, we measured nurse turnover directly from the PBJ data. Although these data are of higher validity compared with survey measures of staff,[51] and are auditable to ensure accuracy, they are self-reported by the nursing homes. However, due to the detailed daily data, we were able to calculate turnover more precisely around the survey date compared with other studies that use calendar year measures. Although this study suggests staff turnover is important to infection control, it is not the only lever that can be used to influence infection control practices. Other strategies to minimize infections include the following: increasing education of infection prevention,[52] increasing opportunities for education after orientation,[31,53,54] using quality improvement tools for infection control as part of the facilities Quality Assurance Performance Improvement Program,[55] and empowering all staff to feel a part of the infection control initiatives.[31] Finally, it is important to acknowledge the role that organizational cultural values play in turnover of all types of nursing staff that also influence patient outcomes,[42,43] which we were unable to measure in this study.

5 | CONCLUSIONS

Nurse turnover was significantly associated with infection control citations but had a modest association with the scope of such citations. Policy makers and nursing home managers should consider reforms and strategies aimed at limiting staff turnover to improve infection control and minimize the likelihood of future outbreaks of COVID-19 and other infectious diseases at nursing homes.

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SUPPORTING INFORMATION

Additional supporting information may be found in the online version of the article at the publisher's website.

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