

Nurse Staffing and Coronavirus Infections in California Nursing Homes

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Abstract

In the United States, 1.4 million nursing home residents have been severely impacted by the COVID-19 pandemic with at least 25,923 resident and 449 staff deaths reported from the virus by June 1, 2020. The majority of residents have chronic illnesses and conditions and are vulnerable to infections and many share rooms and have congregated meals. There was evidence of inadequate registered nurse (RN) staffing levels and infection control procedures in many nursing homes prior to the outbreak of the virus. The aim of this study was to examine the relationship of nurse staffing in California nursing homes and compare homes with and without COVID-19 residents. Study data were from both the California and Los Angeles Departments of Public Health and as well as news organizations on nursing homes reporting COVID-19 infections between March and May 4, 2020. Results indicate that nursing homes with total RN staffing levels under the recommended minimum standard (0.75 hours per resident day) had a two times greater probability of having COVID-19 resident infections. Nursing homes with lower Medicare five-star ratings on total nurse and RN staffing levels (adjusted for acuity), higher total health deficiencies, and more beds had a higher probability of having COVID-19 residents. Nursing homes with low RN and total staffing levels appear to leave residents vulnerable to COVID-19 infections. Establishing minimum staffing standards at the federal and state levels could prevent this in the future.

Keywords

COVID-19, nurse staffing, nursing homes

The coronavirus pandemic has swept through U.S. nursing homes resulting in at least 25,923 resident and 449 staff deaths with 80% of nursing homes reporting by June 1, 2020 (Centers for Medicare & Medicaid Services, [CMS], 2020c). The country's 1.4 million nursing home residents living in 15,600 nursing homes are a highly vulnerable population (CMS, 2016). Most of the residents are older than 65 years (85%) and over 40% are aged 85 and older. The majority of residents have many chronic illnesses and conditions and over 60% need assistance with four or more activities of daily living and/or have cognitive impairments (CMS, 2016). These residents are vulnerable to infections particularly because many share rooms with two or more residents and have congregated meals.

The Centers for Disease Control and Prevention (CDCP, 2020) analyzed the first COVID-19 outbreak

in a nursing home in King County Washington where the virus initially spread rapidly to 129 residents, staff, and visitors and the facility eventually had 40 deaths (Sacchetti & Swaine, 2020). The report found several factors that contributed to the spread of the infection including failure to report a respiratory disease outbreak, staff members who worked while symptomatic and in more than one facility, inadequate familiarity and adherence to standard infection control practices, inadequate supplies of personal protective equipment

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(PPE) and hand sanitizers, delayed recognition of the virus based on signs and symptoms, and failure to hold consistent and effective quality assurance performance improvement meetings that could have identified issues earlier.

As the COVID-19 pandemic has spread rapidly throughout nursing homes, two major factors have been described by the news media as contributing to large numbers of cases. One is the inadequate staffing levels in many nursing homes prior to the outbreak of the virus (Charbria & Gomez, 2020; Goldstein, Silver-Greenberg & Gebeloff, 2020; Mathews et al., 2020; Rau & Almendrala, 2020). The second is previous violations of infection control regulations; in fact, as many as 40% of nursing homes with COVID-19-positive residents had been previously cited for infection-control infractions (Cenziper et al., 2020; Rau, 2020). This was recently confirmed by the General Accountability Office, that found infection control is the most common type of nursing home deficiency (U.S. Government Accountability Office [U.S. GAO], 2020).

The aim of this study is to determine whether nurse staffing in nursing homes was related to reports of COVID-19 nursing home residents in the early months of the pandemic. The study compared nurse staffing in California nursing homes with and without residents with COVID-19 infections. In addition, the study examined the relationship of nurse staffing to nursing home infection control deficiencies, total health deficiencies, bed size, and ownership.

Background

Infections

Among U.S. nursing home residents, infections are considered to be the leading cause of morbidity and mortality. Research studies have estimated 1.6 to 3.8 million infections in U.S. long-term care facilities per year (3–7 infections per 1,000 residents; Jackson et al., 1992; Lee et al., 1992; Richards, 2002; K. B. Stevenson, 1999; Strausbaugh & Joseph, 2000). Common infections include urinary tract, pneumonia, influenza, enteric illnesses, skin and soft tissue infections, and conjunctivitis. The cost of treatments and hospitalizations for nursing home infections is high, and infections often result in decreased quality of life, pain, and deaths that are estimated to be as high as 380,000 per year (Richards, 2002).

When the CMS updated its Conditions of Participation regulations in 2016 (U.S. Department of Health and Human Services, Centers for Medicare & Medicaid Services, 2016) and its survey and certification procedures (CMS, 2017a), the requirements for infection control were increased. The law requires each nursing home to establish and maintain an infection control

program designed to provide a safe, sanitary, and comfortable environment in which residents reside and to help prevent the development and transmission of disease and infection. Facilities must have “a system for preventing, identifying, reporting, investigating, and controlling infections and communicable diseases for all residents, staff, volunteers, visitors, and other individuals . . . following accepted national standards.” In addition, facilities must develop written policies and procedures and implement a system for documenting incidents and corrective actions and facilities must employ a part-time infection preventionist.

CMS is responsible for overseeing the survey and certification process for U.S. nursing homes through regular surveys (every 9–15 months) and complaint investigations conducted by state agencies. During the past 2 regular inspections, 63% of U.S. nursing homes received deficiencies for one or more violations of CMS infection control regulations (Rau, 2020). Violations were more common at homes with fewer nurses and aides than at facilities with higher staffing levels. The U.S. GAO (2020) reported that 82% of U.S. nursing homes had an infection prevention and control deficiency between 2013 and 2017. These failings included not using proper hand washing and isolation procedures and not using masks and other PPE to control the spread of infections. Poor infection control practices are expected to make nursing homes more susceptible to COVID-19 infection.

At the beginning of the pandemic, new federal infection control directives for nursing homes were modified and enhanced to address COVID-19 infections including the use of PPE, sanitation measures, screening staff, cancelling nonessential group activities, and limiting visitors (CDCP, 2020; CMS, 2020a, 2020b). Various professional groups have also made efforts to assist nursing homes in following CDCP care guidelines for COVID-19 cases by recommending ways to manage outbreaks, clinical diagnosis, and management of COVID-19 in older patients, as well as ways to improve communication and coordination with hospitals and emergency care providers (Bakerjian, 2020; Gaur et al., 2020; Levine et al., 2020).

Nurse Staffing

Infection control regulations are the responsibility of nursing staff in nursing homes. Nursing homes must meet federal regulations to ensure they have sufficient nursing staff with the appropriate competencies and skills to provide nursing and related services. Nursing homes must assure resident safety and that residents attain or maintain the highest practicable level of physical, mental, and psychosocial well-being. Nurse staffing levels must be based on the care needs of residents using

individual resident assessments and plans of care (see CMS, 2017a; U.S. Department of Health and Human Services, Centers for Medicare & Medicaid Services, 2016).

Although minimum staffing levels are not directly specified, each facility must have sufficient numbers of registered nurse (RNs), licensed vocational and practical nurses (LVNs/LPNs), and certified nursing assistants (CNAs) on a 24-hour basis to provide nursing care to all residents including a charge nurse on each shift, an RN for at least 8 consecutive hours a day, 7 days a week, and a designated RN to serve as the director of nursing on a full-time basis, unless the facility has a CMS waiver (CMS, 2016). Nursing homes are required to submit payroll-based journal (PBJ) data to CMS detailing the actual number of hours by the type of nursing staff on a daily basis (CMS, 2017b).

Many research studies have found that higher nurse staffing improves both the process and outcome measures of nursing home quality. The impact of RNs is particularly positive, but total nursing staff (including LVNs/LPNs and CNAs) are basic to the provision of good care. Higher RN staffing levels are associated with better resident care quality in terms of fewer pressure ulcers; lower restraint use; decreased infections; lower pain; improved activities of daily living (ADL) independence; less weight loss, dehydration, and insufficient morning care; less improper and overuse of antipsychotics; and lower mortality rates (Bostick et al., 2006; Castle, 2008; Castle & Anderson, 2011; Dellefield et al., 2015). Higher nurse staffing levels in nursing homes have been found to reduce emergency room use and rehospitalizations (Grabowski et al., 2008; Spector et al., 2013). Finally, higher nurse staffing levels are significantly related to lower deficiencies (violations of federal regulations) for poor quality issued by state surveyors (Castle et al., 2011; Lin, 2014).

There is also a growing body of evidence on the negative impact of inadequate staffing levels on omissions in nursing care. Missed or omitted care has been found to be associated with adverse events including pressure ulcers, medication errors, new infections, intravenous fluids running dry or leaking, poor patient safety culture, and patient falls (Dabney & Kalisch, 2015; Hessels et al., 2019; Kalisch et al., 2011, 2014). A recent survey of RNs in nursing homes found that 72% reported missing one or more necessary care tasks on their last shift due to the lack of time or resources (White & Aiken McHugh, 2019). Missed care was also found to be related to high levels of RNs burnout and job dissatisfaction.

Study Rationale and Hypotheses

Research suggests that the majority of U.S. nursing homes do not provide sufficient staffing to meet the

basic quality standards. Over half of U.S. nursing homes had lower RN, CNA, and total nurse staffing levels than those recommended by experts and one quarter of nursing homes had very low staffing (below 3.53 total nursing hours) in 2014 (Harrington et al., 2016). Overall, 75% of nursing homes almost never met the CMS expected RN staffing levels based on resident acuity in the 2017 to 2018 period (Geng et al., 2019). The study also found wide variability in staffing levels within facilities with very low staffing on weekends and holidays (Geng et al., 2019; Rau, 2018).

This study examined nursing hours per resident data to determine whether the staffing levels were related to nursing homes having COVID-19 residents during the early period of the pandemic. It was hypothesized that nursing homes with higher staffing hours per resident day (hprd) will be less likely to have residents with COVID-19.

Minimum Nurse Staffing Levels

In 2001, a CMS study identified minimum staffing levels that prevented harm and jeopardy to residents. The study found that the minimum staffing levels for long-stay residents should be 0.75 RN hprd, 0.55 LVNs/LPNs hprd, and 2.8 for CNA hprd, for a total of 4.1 nursing hprd (CMS, 2001). These staffing recommendations have been endorsed by organizations that have also suggested that nursing homes should have 24-hour RN care (American Nurses' Association, 2014; Coalition of Geriatric Nursing Organizations, 2013; Institute of Medicine, 2004). An expert panel recommended even higher staffing standards (a total of 4.55 hprd) to improve the quality of nursing home care, along with increased in staffing for higher resident acuity (Harrington et al., 2000).

California, such as a number of states, has established its own minimum staffing requirements for nursing homes. California law requires all nursing homes to provide at least 3.5 nursing hprd, although some waivers are allowed (California Health & Safety Code §1276.5.). California and most state minimum staffing standards are well below the levels recommended by researchers and experts to meet the needs of each resident (Harrington et al., In Press). A 2017 report on California nursing home staffing showed that almost three quarters of the nursing homes in California were below the CMS recommended minimum standard for total nursing hours of 4.1 hprd, RN staffing level of 0.75 hprd, and CNA staffing level of 2.8 hprd (Ross & Harrington, 2017). Twenty-five percent of California nursing homes had dangerously low staffing, that is, staffing for these facilities was within the lowest quartile of total staffing (less than 3.50 hprd).

Support for the need for minimum staffing standards has been shown in other research studies including an observational study (Schnelle et al., 2004) and a simulation model for CNA staffing that showed the need to adjust staffing upward for higher acuity residents (ranging from 2.8 to 3.6 hprd; Schnelle et al., 2016; Simmons & Schnelle, 2004). Thus, this study hypothesized that nursing homes with less than 0.75 RN hprd and less than 4.1 total nursing hprd (RNs, LVNs/LPNs, and CNA) were more likely to have residents with COVID-19.

CMS Nurse Staffing Ratings for Medicare five-Star Nursing Home Compare Website

CMS's five-star Medicare Nursing Home Compare rating system developed a method to adjust reported nurse staffing levels for the case-mix of residents in each nursing home based on its Resource Utilization Group (RUG) acuity scores (CMS, 2019a, 2019b). The CMS website created two ratings based on two quarterly case-mix adjusted measures: (a) total nursing hprd (RN + LPN + nurse aide hours) and (b) RN hprd, using reported staffing hours from the CMS PBJ system. Total nursing and RN hours were calculated by multiplying nursing times by the number of residents in each RUG-IV. Aggregate total staffing and RN hours are summed across all the days using the RUG-IV groups as the numerator with the total number of resident days as the denominator (CMS, 2019a, 2019b). The resulting information is then published as separate ratings for the website that take into account resident case-mix. This study's hypothesis was that nursing homes with higher star ratings for RNs and for total nursing staff on CMS five-star Medicare Nursing Home Compare website are less likely to have residents with COVID-19.

Other Selected Factors

For this study, four key variables were considered as potential contributors to whether a nursing home had COVID-19 residents. The total number of health deficiencies in the past year is considered the key indicator on the Nursing Home Compare website because these are based on state surveyor observations, interviews, record reviews, and other data used to evaluate compliance with all federal health regulatory requirements. Infection control violations, one component of total health deficiencies identified by state surveyors, could be relevant to COVID-19 infection (U.S. GAO, 2020). The number of beds were expected to be related to infection outbreaks because facilities with more beds will have higher exposure among staff and residents. Finally, for-profit ownership (compared with nonprofit

and government owners) has been found, in previous studies, to be related to lower staffing levels and therefore may be a factor in exposure to COVID-19 (Grabowski et al., 2013; Harrington et al., 2012).

Methodology

The study included licensed and Medicare–Medicaid-certified nursing homes in California (excluding assisted living and residential care facilities). The study identified nursing homes that had reported COVID-19 infections in staff and/or residents between March 15 and May 4, 2020. This study relied on three data sources to identify nursing homes that had COVID-19: (a) the LA County Department of Public Health reports of April 15, April 21, and May 4, 2020 and (b) California Department of Public Health reports on April 17 and May 3, 2020; and California nursing home outbreaks reported by news organizations between March 15 and May 4, 2020. News reports were reviewed because at least one nursing home with a large outbreak, that evacuated its residents in March, was not included on the state list. By using overlapping source information, we increased the probability that all facilities with outbreaks were included in the listing.

By combining these data sources, the authors identified a total of 272 California nursing homes that reported residents (along with some staff) with COVID-19 infections. The 102 California nursing homes that reported COVID-19-positive staff but no residents with COVID-19 were excluded from the study. The facilities that had COVID-19-positive staff only were excluded and examined separately because they may have been able to prevent the spread to residents. Thus, the study included a total of 819 nursing homes that did not report residents with COVID-19 and 272 nursing homes reporting one or more COVID-19 residents, for a total of 1,091 certified nursing homes in the study. It is possible that the reports of COVID-19 residents may not have been entirely accurate or complete because of limited testing of staff and residents during the study period as well as the reliance on facility self-reporting to Los Angeles county and the California Department of Public Health. No names of individual residents or staff were reported.

For the study, secondary data from CMS data (www.data.medicare.gov) were used. These included RN and total nurse staffing data in hprd, the CMS five-star rating for RNs and for total staffing, total health deficiencies, infection control deficiencies (*yes* = 1), number of licensed beds, and ownership data (for profit = 1, non-profit and government = 0) were obtained. The CMS staffing data were from PBJ reports for the third quarter of 2019 (the most recent available at the time of the analysis) and the remaining CMS data were reported

on the Medicare Nursing Home Compare March 31, 2020 database.

Analyses

We conducted bivariate, correlation, and logistic regression analyses using IBM SPSS Statistics software for MAC, Version 26 (IBM Corp., Armonk, NY). The bivariate analyses compared the nursing homes with COVID-19 residents to nursing homes reporting no COVID-19 residents. For those measures that were binary, we conducted Pearson Chi-square tests for dichotomous measures (i.e., met the staffing standard, for profit, and infection control deficiencies) and analysis of variance (ANOVA) on the measures that were continuous (i.e., nursing hprd, CMS total nurse staffing and RN ratings, number of deficiencies in the most recent year, and number of beds). To explore potential multicollinearity issues among the predictor variables, we conducted Pearson correlational analyses of staffing measures with infection control and total health deficiencies from the most recent year, bed size, and for-profit ownership (compared with nonprofit and government facilities).

The results of the bivariate and correlational analyses guided our inclusion of predictor variables into the logistic regression models. That is, if a variable was significant in the bivariate analysis it was included in the model. The three independent measures selected (health deficiencies, number of beds, and ownership) were found to be associated with staffing measures. While the infection control deficiencies measure was also associated with staffing and facilities having COVID-19 residents, the total deficiencies were a more robust measure of quality and therefore was used in the regressions. In the bivariate analyses, RN hours and total nursing hprd were not as strong as the other four staffing measures so they were not included in the final regressions.

Four logistic regressions analyses were performed to ascertain the effects of staffing, health deficiencies, number of beds, and ownership (for-profit ownership vs. nonprofit/government) on the likelihood that a facility would have COVID-19 residents compared with those without COVID-19 residents. Each regression model examined the effect of four staffing measures separately because of the overlap in the staffing measures—CMS five-star Staffing Rating, CMS five-star RN Staffing Rating, Total Staffing greater or less than 4.1 hprd, and RN Staffing greater or less than 0.75 hprd—while keeping the three other independent variables constant.

Results

Table 1 shows the results of the bivariate analyses. Almost 80% of California nursing homes did not meet the recommended RN staffing levels (0.75 hprd) and 55% did not meet the minimum recommended total nursing standard (4.1 hprd). A larger proportion of nursing homes with COVID-19 residents had total RN staffing levels under the recommended minimum of 0.75 hprd and had total nurse staffing under the recommended level of 4.1 hprd. A higher proportion of nursing homes with COVID-19 residents had one or more deficiencies for infection control violations. It should be noted that 64% of all facilities had one or more infection control violations in the most recent survey period. A higher proportion of nursing homes with COVID-19 residents were for-profit owners.

Table 1 also shows a higher proportion of nursing homes with COVID-19 residents had lower RN hprd and lower total nursing hprd. In addition, a higher proportion of facilities with COVID-19 residents had lower CMS Medicare five-star total staffing and lower RN ratings as hypothesized. Facilities with COVID-19 residents also had more deficiencies and were larger in size than facilities without COVID-19.

Table 2 shows the Pearson correlations among the staffing measures on four staffing variables with selected nursing home characteristics. These correlations ranged from weak ($r < .1-.3$) to medium ($r < .3-.4$). RN and total nurse staffing levels (hprd) were negatively related to having any infection control deficiencies, total health deficiencies, the number of beds, and for-profit ownership. Facilities that had higher CMS five-star total staffing or RN ratings had fewer infection control deficiencies, lower total health deficiencies, and were less likely to be for profit, but the number of beds was not significant. The relationship between the staffing measures and total deficiencies were stronger than for the infection control measure.

Table 3 shows the logistic regression results of four staffing models to evaluate the effects of staffing, health deficiencies, number of beds, and ownership on the probability of whether a facility had COVID-19 residents. Model 1 shows that the odds of nursing homes with COVID-19 having low RN hours (less than 0.75 hprd) was two times greater than nursing homes without COVID-19 residents. While COVID-19 nursing homes had higher odds of having health deficiencies and a larger number of beds, the impact of these variables was less than if a nursing home had low RN hours.

Model 2 shows that nursing homes with COVID-19 residents were not more likely to have total staffing below the 4.1 hprd standard than nursing homes without COVID-19 residents when controlling for total health deficiencies and bed size which were significant.

Table 1. Bivariate Analyses for California Nursing Homes With and Without COVID-19.

Independent variables	Nursing homes with COVID-19 residents (N = 272)		Nursing homes without COVID-19 residents (N = 819)		Total nursing homes (N = 1,091)		Pearson chi-square
	n	Percent	n	Percent	n	Percent	
Total RN Staffing							
Under 0.75 RN hprd	236	89.1	587	76.2	823	79.5	19.903***
0.75 RN hprd or higher	29	10.9	183	23.8	212	20.5	
					1,035		
Total nurse staffing							
Under 4.1 hprd	166	62.60	401	52.1	567	54.8	8.881*
4.10 hprd or higher	99	37.4	369	47.9	468	45.2	
					1,035		
Any infection control							
Deficiencies	194	71.3	504	61.5	698	64.0	8.483*
No deficiencies	78	28.7	315	38.5	393	36.0	
	–	–	–	–	1,091		
Ownership							
For profit	245	90.1	675	82.4	920	84.3	9.055**
Nonprofit/government	27	9.9	144	17.6	171	15.7	
					1,091		

	Nursing homes with COVID-19 residents (N = 272)		Nursing homes without COVID-19 residents (N = 819)		Total nursing homes (N = 1,091)		ANOVA F
	Mean		Mean		Mean		
	n	(SD)	n	(SD)	n	(SD)	
RN staffing hprd	265	0.56 (0.52)	770	0.66 (0.64)	1035	0.64 (0.61)	5.788*
Total nurse staffing hprd	265	4.20 (0.94)	770	4.39 (1.20)	1035	4.34 (1.14)	5.409*
CMS medicare-five-star nurse staffing rating	263	2.69 (0.95)	771	2.95 (1.10)	1034	2.88 (1.07)	11.681***
CMS medicare five-star RN staffing rating	263	2.30 (1.05)	771	2.61 (1.20)	1034	2.53 (1.17)	14.522***
Number of health deficiencies	271	15.4 (8.1)	814	12.4 (8.0)	1,085	13.1 (8.1)	29.175***
Number of beds	272	118.1 (70.5)	819	92.4 (48.8)	1,091	98.8 (56.1)	44.650***

Note. ANOVA = analysis of variance; CMS = Centers for Medicare & Medicaid Services; hprd = hours per resident day; RN = registered nurse.

* $p < .05$. ** $p < .01$. *** $p < .001$.

Models 3 and 4 show that lower CMS five-star total staffing ratings (Model 3) and lower RN ratings (Model 4; both adjusted for resident acuity), higher numbers of health deficiencies, and a greater number of beds increased the likelihood that nursing homes would have COVID-19 residents. Separate logistic regressions that substituted infection control violations for total health deficiencies showed similar findings to those for total health deficiencies (table not shown).

Since nursing homes located in areas with higher COVID-19 positive infection rates in the general population would be more likely to have staff or residents exposed to COVID-19, we conducted a separate analysis of nursing homes located in Los Angeles county which had the highest number of cases (341 per 100,000 population on May 13, 2020) of any California county (Los Angeles Times Staff, 2020). In the county, 163 (48.5%)

nursing homes reported COVID-19 residents and 173 reported no COVID-19 residents. The logistic regression analysis showed similar patterns where RN hours below 0.75 hprd and total nursing hours below 4.1 hprd were significantly related to increased probability of nursing homes having COVID-19 residents. The CMS five-star staffing and RN ratings were not significant variables in the models (no tables shown).

We also did a separate ANOVA analysis that combined the 102 nursing homes reporting COVID-19 staff only as well as the 272 nursing homes with COVID-19 residents. These analyses found that a significantly higher proportion of facilities with COVID-19 had a lower RN hprd per resident day, lower nurse staffing ratings, and lower RN staffing ratings, although the relationships were not as strong as the ANOVAs for nursing homes with only COVID-19 residents.

Table 2. Pearson Correlations for Staffing Measures and Selected Characteristics of California Nursing Homes.

Nursing home measures	RN staffing hprd	Total nurse staffing hprd	CMS medicare five-star RN staffing rating	CMS medicare-five-star nurse staffing rating
Any infection control deficiencies	-.076**	-.093**	-.121**	-.112**
Total health deficiencies	-.218**	-.222**	-.236**	-.233**
Number of beds	-.207**	-.237**	-.047	-.045
For profit	-.375**	-.371**	-.331**	-.322**

Note. CMS = Centers for Medicare & Medicaid Services; hprd = hours per resident day; RN = registered nurse.

**Correlation is significant at the 0.01 level (2-tailed).

Table 3. Logistic Regression Models of Staffing, Quality of Care, Beds, and Ownership in Facilities With COVID-19 Residents.

Model 1				Model 2			
RN staffing on nursing homes with COVID residents				Total staffing on nursing homes with COVID residents			
	B/SE	Odds ratio	95% CI		B/SE	Odds ratio	95% CI
RN staffing less than 0.75 hprd ^a	0.735** (0.234)	2.086	[1.318, 3.301]	Total staffing less than 4.1 hprd ^c	0.238 (0.157)	1.269	[0.932, 1.728]
Total health deficiencies	0.020* (0.009)	1.021	[1.002, 1.040]	Total health deficiencies	0.022* (0.009)	1.022	[1.004, 1.041]
Total beds	0.007*** (0.001)	1.007	[1.004, 1.010]	Total beds	0.007*** (0.001)	1.007	[1.004, 1.010]
For profit ^b	0.208 (0.250)	1.231	[.753, 2.010]	For profit ^b	0.343 (0.249)	1.409	[0.864 – 2.296]
Constant	-2.862*** (0.301)	0.057		Constant	-2.546*** (0.273)	0.078	
Model 3				Model 4			
CMS medicare five-star staffing rating on nursing homes with COVID residents				CMS medicare five-star RN staffing rating on nursing homes with COVID residents			
Medicare five-star nurse staffing rating	-0.185* (0.077)	0.831	[0.715, 0.966]	Medicare five-star RN staffing rating	-0.202** (0.072)	0.817	[0.710, 0.941]
Total health deficiencies	0.020* -0.01	1.020	[1.001, 1.040]	Total health deficiencies	0.020* (0.010)	1.020	[1.001, 1.039]
Total beds	0.007*** (0.001)	1.007	[1.004, 1.010]	Total beds	0.007*** (0.001)	1.007	[1.004, 1.010]
For profit ^b	-0.318 (0.246)	1.374	[0.848, 2.226]	For profit ^b	-0.289 (0.247)	1.335	[0.823, 2.165]
Constant	-1.864*** (0.382)	0.155		Constant	-1.861*** (0.355)	0.156	

Note. CMS = Centers for Medicare & Medicaid Services; hprd = hours per resident day; RN = registered nurse.

^aRN staffing equal to or greater than 0.75 hprd is the reference group.

^bNonprofit and government homes is the reference group.

^cTotal staffing equal to or greater than 4.1 hprd is the reference group.

* $p < .05$. ** $p < .01$. *** $p < .001$.

Discussion

This study was designed to examine the effects of staffing on nursing homes that had COVID-19-positive residents in California in the early period of the pandemic (prior to May 4, 2020). The odds that nursing homes with

COVID-19 residents had low RN hours (less than 0.75 hprd) was two times greater than nursing homes without COVID-19 residents. Nursing homes with COVID-19 residents were significantly associated with lower CMS nurse staffing and RN ratings than nursing homes

without COVID-19 residents. While low total nurse staffing hours (below 4.1 hprd) was associated with having COVID-19-positive residents on the unadjusted ANOVA test, the logistic regression model that took into consideration the effects of health deficiencies, bed size, and ownership, the total nurse staffing hours became nonsignificant.

Nursing homes are required by federal law to meet the needs of their residents and to maintain the highest practicable level of well-being and this requires adjusting staffing to meet the acuity levels of residents. The study found that about 80% of California nursing homes did not meet the minimum RN standards (0.75 RN or higher hprd) and 55% did not meet the total nursing standards (4.1 hprd) that were first identified almost 20 years ago (CMS, 2001) and reconfirmed in other studies (CMS, 2019a, 2019b; Schnelle et al., 2004, 2016). This study suggests that California nursing homes that met the minimum staffing standards may have been able to prevent or delay COVID-19 resident infections. Those nursing homes without COVID-19 residents reported higher total staffing and RN staffing ratings identified by CMS's Medicare Nursing Home Compare website, after adjusting for resident acuity, than those with COVID-19-positive residents.

Facilities that had lower RN and total staffing levels were positively associated with infection control deficiencies, total health deficiencies, larger numbers of beds, and being for profit. When these factors were included in the logistic models, the most important predictors were staffing, deficiencies, and greater number of beds.

The findings from this study are consistent with a recent study of Connecticut nursing homes with COVID-19 infections. The likelihood of having one or more cases of COVID-19 infections was found to be related to lower RN staffing minutes, having one to three star facilities, and a high concentration of Medicaid residents or racial/ethnic minorities (Li et al., In Press). Another recent study of nursing homes in 30 states found that larger facility size, urban location, greater percentage of African American residents, non-chain status, and states had an increased probability of having COVID-19 cases (Abrams et al., 2020). The large variations in state testing and reporting of COVID-19 and the evolving epidemiology of COVID-19 between states, however, may complicate the ability to make cross-state comparisons and explain differences in findings in these studies.

Limitations of Current Analysis

The study was limited to only one state and may not be applicable to other states. On the other hand, staffing levels in California nursing homes are similar to the national statistics in that almost three quarters are

below the CMS recommended minimum standard for RN staffing level of .75 hprd and the majority percent had low total staffing levels (Geng et al., 2019; Harrington et al., 2016). The identification of facilities with and without COVID-19 was based largely on facility self-reports with delays in the state collection of data that could have resulted in both incomplete and inaccurate data. The lack of wide-spread testing of nursing home staff and residents during the period probably resulted in an undercounting of facilities that had COVID-19 staff and residents because the virus was known to often be asymptomatic. Moreover, facilities with COVID-19 residents may change from the early to later phases of the pandemic.

While higher staffing levels, infection control, testing of staff and residents, and the use of PPE may delay initial onset of infection and contain its spread, COVID-19 infections may not be entirely preventable. If additional data were available on the number of tests performed, the extent that PPE were available, whether staff received emergency preparedness training to address disasters and pandemics, and better data on staff and resident infections and deaths, it would be easier to study variations and draw better conclusions.

Another limitation was that the time periods from the CMS five-star rating and the staffing values were from the third quarter of 2019 and may have been different from the ratings and staffing at the time of the COVID-19 study period. That said, we anticipate if anything, the staffing values at the beginning of the outbreak may have declined because of reduced federal and state oversight, staffing shortages associated with a reluctance to work and child care issues in the COVID-19 environment, and staff infections. If anything, the results may be magnified in the same direction.

Implications for Policy

Previous studies have identified minimum levels of nurse staffing that should be met to ensure the health and safety of residents (CMS, 2001; Harrington et al., 2016; Schnelle et al., 2004, 2016). Moreover, experts have made strong recommendations that CMS and states should adopt higher minimum staffing standards (American Nurses' Association, 2014; Coalition of Geriatric Nursing Organizations, 2013; Harrington et al., 2016). Inadequate nurse staffing levels have been identified in most U.S. nursing homes prior to the pandemic (Geng et al., 2019; Harrington et al., 2017). The negative consequences of inadequate staffing have been identified in many research studies over the past 20 years, which includes infections that cause widespread harm and death to nursing home residents. This study shows that nursing homes with low RN and total nurse staffing appear to leave residents vulnerable to

COVID-19 infections. Establishing minimum staffing standards at the federal and state levels could prevent low RN and total staffing in nursing homes and improve the quality of care.

Many studies by the General Accountability Office (2007, 2009a, 2009b) and the Office of the Inspector General (2014, 2019) have shown the on-going poor quality of nursing home care and the ineffective federal/state enforcement system (Harrington et al., 2020). Deficiencies for low or inadequate staffing levels are rarely issued by state inspectors, and CMS does not have guidelines for penalties for staffing violations (Edelman, 2014). In 2018, almost all staffing deficiencies (97%) were inaccurately categorized as not causing harm and therefore few sanctions were issued (Edelman, 2019).

California has had a long history of poor regulatory oversight. In 2014, the California Department of Public Health had a backlog of about 10,000 nursing home complaint investigations and incidents (California State Auditor, 2014). In 2018 and 2020, the California State Auditor (2018, 2020) found that the Department was still not completing its required inspections and not providing effective state oversight of nursing homes resulting in substandard quality of care in some facilities.

Implications for Practice

In this study, we found about 84% of California nursing homes were for profit compared with 70% of nursing homes nationally (CMS, 2016). As we show in this study, California for-profit nursing homes were associated with lower RN and total staffing hprd and lower Medicare five-star total nursing and RN staffing ratings, after adjusting for acuity. For-profit nursing homes were also associated with more health deficiencies compared with nonprofit and government facilities.

These findings on low staffing and quality in for-profit nursing homes are consistent with previous studies (Comondore et al., 2009; Harrington et al., 2012; D. Stevenson et al., 2013). Moreover, facilities with the highest profit margins have been found to have the poorest quality (O'Neill et al., 2003).

Nursing home owners, administrators, and directors of nursing appear to generally substitute LVN/LPNs for RNs in nursing homes as a way to control costs. RNs are essential for conducting resident assessments, developing care plans, providing and overseeing nursing care, and ensuring adequate infection control in nursing homes. This study demonstrates the need for nursing homes to recognize that keeping RN staffing levels low can potentially lead to serious negative consequences for quality of care, such as during the outbreak of COVID-19.

Implications for Future Research

The study results also raise questions about staffing levels and racial/ethnic disparities in nursing homes with COVID-19 as recently shown (Abrams et al., 2020; Li et al., In Press; Gebeloff et al., 2020). Previous studies have identified that compared with Whites, racial/ethnic minorities tend to be cared for in nursing homes with limited clinical and financial resources, low nurse staffing levels, and a relatively high number of care deficiency citations (Li, Harrington, Mukamel, et al., 2015; Li, Harrington, Temkin-Greener, et al., 2015).

Placing racial/ethnic minorities and those who are dual eligible for Medicare and Medicaid in low-staffed nursing homes can have negative consequences for resident outcomes. Residents who are dual eligible are more likely to be discharged to nursing homes with low nurse-to-patient ratios and are more likely to become long-stay nursing home residents than Medicare-only beneficiaries if treated in nursing homes with low nurse-to-patient ratios (Rahman et al., 2014). Additional research should examine the complex factors associated with racial/ethnic minorities living in nursing homes with COVID-19 infections such as low staffing and high deficiencies.

Another research area is to examine the relationship between the cumulative number of infections and deaths with nurse staffing levels as was examined by Li et al. (In Press). Moreover, it would be valuable to study the effect of nursing home working conditions, health and sick leave benefits, working in multiple facilities, hazard pay, and other factors on nurses and other health care workers and residents during the COVID-19 pandemic.

Implications for Hospital and Health Plan Networks and Discharge Planning

Nursing homes with higher CMS Medicare five-star Nursing Home Compare website ratings for RNs and total nurse staffing hours (case-mix adjusted for resident acuity) were less likely to have COVID-19-positive residents. While total health deficiencies and total beds were also positive predictors of having COVID-19 residents, the staffing measures, especially RN hours, were the strongest predictors.

These findings give support to hospitals, health plans, discharge planners, and case managers to use nursing home rating systems to establish high-quality nursing home networks and to help consumers chose high-quality nursing homes for postacute care (Graham et al., 2018; Harrington et al., 2017). The CMS Nursing Home Compare website has been found to be useful for consumers in making choices and resulted in nursing homes improving their scores on certain quality

measures (Werner et al., 2016). A clinical trial that used a personalized version of Nursing Home Compare in the hospital discharge planning process found greater resident satisfaction, residents being more likely to go to higher ranked nursing homes and traveling further to nursing homes, and residents having shorter hospital stays, when compared with the control group (Mukamel et al., 2016).

More recently, a study found that discharge to higher quality nursing homes led to significantly lower mortality, fewer days in the nursing home, fewer hospital readmissions, and more days at home or with home health care during the first 6 months post nursing home admission (Cornell et al., 2019). The research shows the importance of having well-staffed and safe nursing homes for residents and their families.

Conclusion

Evidence supports the fact that low staffing contributed to poor quality California nursing homes being more vulnerable to the COVID-19 pandemic. We conclude that health professionals, hospitals, and health plans could identify nursing homes that are at risk for infections and other poor outcomes if they more frequently used publicly available information about nursing home staffing and the quality of care. This also leads to our conclusion that to prevent, delay, and manage nursing home infections such as has occurred during the current COVID-19 pandemic, states, and CMS need to adopt stronger minimum staffing requirements, particularly to increase RN and total nurse staffing levels in all nursing homes. This would address the fundamental underlying problem of low staffing in many California and U. S. nursing homes that jeopardizes the health and safety of residents.

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